THE REFINER AND NATURAL GASOLINE MANUFACTURER

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Specifications for Efficient Laboratory Air Pressure Filter

Gasoline Manufacturers Ready to Push Their Product

Laboratory Control of Boiler Water

Absorbent Oil for Natural Gasoline Manufacturers

Economic Value of Natural Gasoline

Four Tube Condenser Box Saves Time

Vol. 5 No. 6 JUNE, 1925 $1.00 Per Year

Suitable Laboratory for Refinery of Moderate Size

By H. L. Kauffman

The laboratory is essential to the refinery but only the proper laboratory is efficient for a specific refinery. In this article the writer takes up in detail the building, the equipment and the force adopted for the refinery built to serve the refining plant of the Producers and Refiners Corporation at Parco, Wyoming. This is editorial matter calculated to so inform an executive that he may use it for solving his own laboratory problem.

Laboratory Essential to Quality Product from Natural Gasoline Plant

By W. R. Lentz

Appreciation of the chemist has been more pronounced in the natural gasoline industry in the past five years than in any other division of the petroleum industry. Manufacturers of this product came to the point where only a better product could improve their economic position. To gain a better product required the check of the laboratory. This article deals with the place of the laboratory at the gasoline plant.

BRAUN
Braun Gasoline Final Coolers installed on the effluent gasoline lines from box condensers. By cooling to a temperature of 80° with water at 75°, weathering losses are minimized and box condenser cooling capacity is increased.
C. F. BRAUN & CO.
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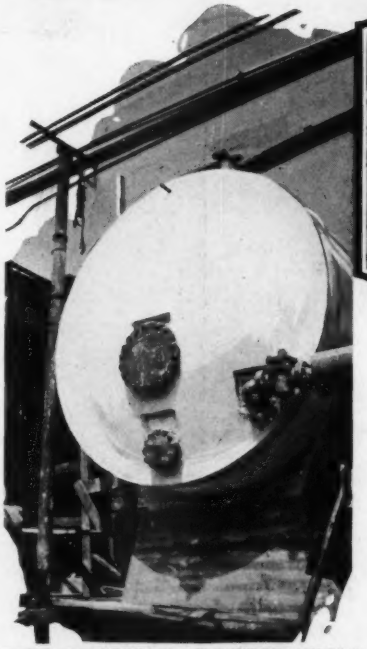
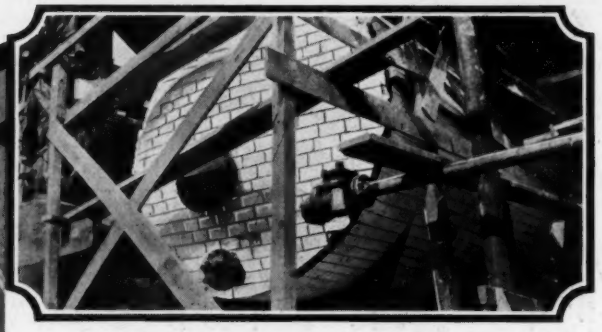
BRAUN
HEAT EXCHANGERS

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

SIL-O-CEL
HEAT INSULATION





THE LEAMON PROCESS STILL pictured above is insulated with five inches (2 courses) of Sil-O-Cel Standard Brick. Sealed with Sil-O-Cel Hard Finish Cement this construction presents an even, jointless surface that may be waterproofed effectively at minimum cost.

Although we supply Sil-O-Cel Insulation also in the form of block and cements, as well as powder and C-3 aggregate, we strongly recommend the use of brick for the insulation of this kind of equipment.

TO ANY ENGINEER who is interested in this topic we shall be glad to send our refinery handbook, a terse discussion of the methods of insulating all types of refinery and gasoline plant equipment. Please address our Division Office, listed below, which is nearest you.

Why Brick Insulation?

THE EASIEST WAY to insulate steel surfaces against heat radiation losses is with Sil-O-Cel Insulating Brick. The most efficient insulated construction also is attained by using insulating material in this form. And the cost is lowest by far, when you compare on the basis of heat savings and length of service from the insulation.

ON THE SHELLS of stills, absorbers, heaters, exchangers, towers and so forth, curved or flat, Sil-O-Cel brick in thicknesses of 1¼ inches or 2½ inches are simply cemented to the steel, and secured in place by wire re-inforcing. A final coating of Sil-O-Cel Hard Finish Cement seals all joints and leaves an even, unbroken surface, an ideal base for a waterproofing compound, such as Celcote.

There are no gaps in this insulated construction, where air could get through and circulate inside the insulation. Every bit of the insulation is in absolute contact with the steel—and every bit of the steel can be covered. Removing a portion of the insulation for attention to the steel underneath, entails no great amount of trouble. The insulating brick removed can be replaced with practically no loss.

BUT THE FIRST ADVANTAGE of Sil-O-Cel Brick is their wide adaptability. The "fire brick size" insulating brick that you use in still-furnace walls and boiler settings, where direct temperatures may run as high as 1600° F, are the most efficient insulating material you can get for any heated equipment in refinery or gasoline plant. You stock only one grade, one shape, one size of insulating material when you standardize on Sil-O-Cel brick insulation over all hot steel surfaces.

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PRODUCES QUALITY GASOLINE

Facts from performance

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The furnace design of the Jenkins Cracking Process with the relatively low temperature required, uses an exceptionally small amount of fuel.

You always find in investigating the Jenkins Process that representations of performance are made on a sound conservative business basis, and always fair and safe for the investor.

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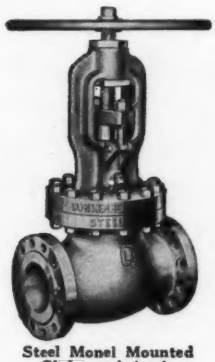

Steel Monel Mounted Globe and Angle

Steel Monel Mounted Swing Check

LUNKENHEIMER
Globe, Angle, and Check Valves

are procurable in a wide range of sizes and patterns, for all prevailing pressures and temperatures. No matter what the service conditions may be, the complete line facilitates the selection of the correct valves for any specific purpose.

And when you select Lunkenheimer Valves, you have the assurance that you have an efficient combination of all the factors which insure dependable and economical valve service—correct design, carefully selected materials, skilled workmanship, and the most modern foundry and manufacturing facilities.

Seating surfaces are regrindable, and all parts, including the seats and discs, may be renewed without removing the valves from the pipe line. All valves can be repacked under pressure when wide open.

Lunkenheimer Distributors, located in all industrial centers, carry large stocks, and render prompt service. Call on them for your requirements.

The Lunkenheimer "Guide to Better Service" is a handy reference book, conveniently arranged to enable you to find at a glance Valves for various pressures and temperatures. The center pages illustrate the application of Lunkenheimer Boiler Mountings conforming to the A. S. M. E. Code. Other pages show a variety of Lunkenheimer Engineering Appliances. A copy of this interesting book is yours for the asking. No obligation.

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Standardization Service
Assures the Right Paint For Each Different Surface

On request, we shall be glad to submit suggestions for a Standardized Color Card, recommending specific paints and colors to suit the individual requirements of your business. Ask our representative to show you samples of these cards. Cook's Standardization Service will enable you to maintain uniformity in your painting; and at the same time cut your costs.

COOK PAINT & VARNISH COMPANY : : *Factories:* Kansas City—St. Louis—Fort Worth

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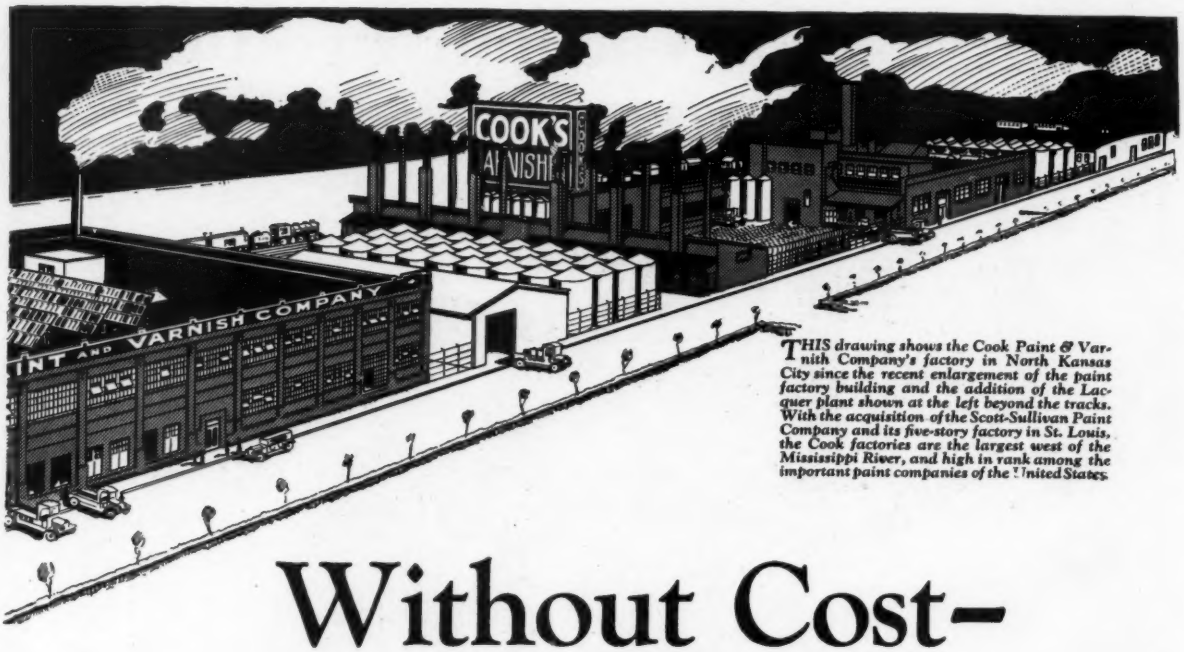

THIS drawing shows the Cook Paint & Varnish Company's factory in North Kansas City since the recent enlargement of the paint factory building and the addition of the Lacquer plant shown at the left beyond the tracks. With the acquisition of the Scott-Sullivan Paint Company and its five-story factory in St. Louis, the Cook factories are the largest west of the Mississippi River, and high in rank among the important paint companies of the United States.

Without Cost–

Put a Cook Paint Specialist On Your Staff

Use the Experience of the Cook Organization—
Pioneers In the Development of Specialized Paints for the Oil Industry

Large corporations frequently face what would seem to be a difficult problem in maintaining *uniformity* in painting —uniformity in color, uniformity in quality, uniformity in selection of the right paint for each different surface. Plant managers scattered in many territories frequently are tempted to let their individual preferences interfere with the maintenance of desirable uniformity.

Cook's Standardization Service successfully solves this problem. Our experts help you choose the right paint for every use; they work out a shop practice adapted to your needs; they show you how to save money, produce better results and reduce your upkeep costs. And for the guidance of your managers, we supply a Standardization Color Card made up exclusively for your individual use.

This Color Card assures the right paint for each surface about your plants, not only on the first order but on every subsequent order—whether it is large or small. The Color Card makes ordering easy, as shown by the color and number on the Card. The foreman or the purchasing department simply orders by number the paint, varnish, stain, enamel or lacquer indicated for the purpose desired. The Color Card thus becomes your paint "authority"—saving time, money and cost of supervision.

Branches: Chicago—Omaha—Wichita—Oklahoma City—Tulsa—Dallas—Denver—Kansas City, Kansas—St. Joseph, Missouri

COOK PAINT & VARNISH CO., Dept. 1004, Kansas City, Mo.

Gentlemen: Please send me, without obligation on my part, your booklet on "Specialized Paints for the Oil Industry." We are

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*Name of Company*_____

*Individual To Address*_____ Title_____

*Address*_____

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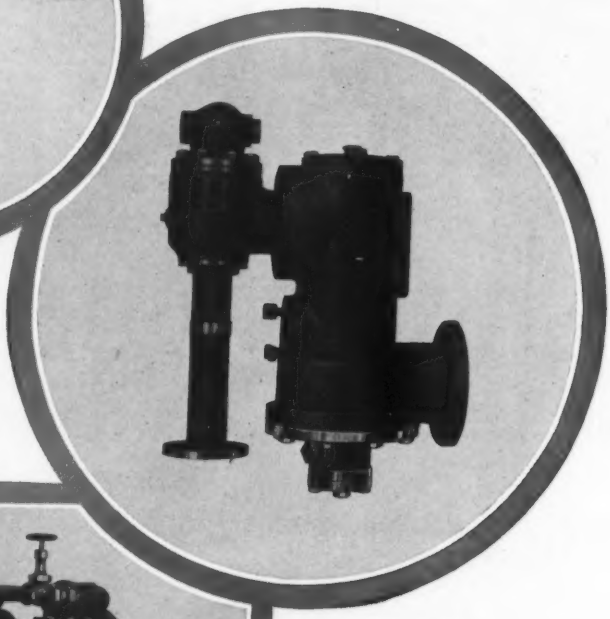
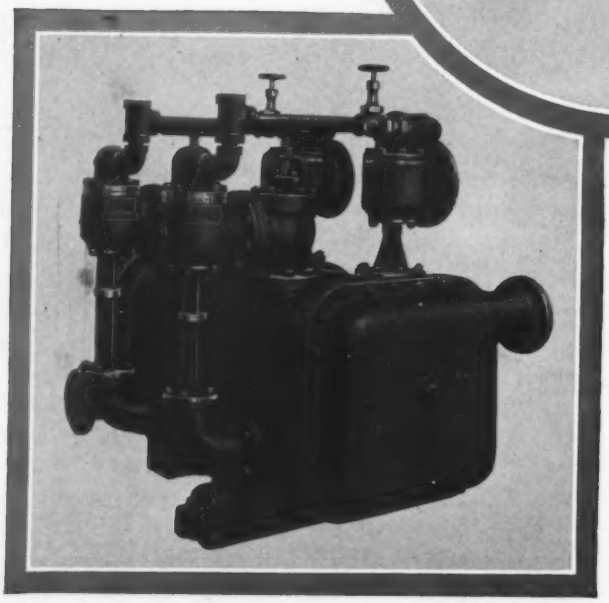
The A-B-C of Vacuum Production

Type "A"
Single-Stage High Vacuum Ejector



Type "B"
Two-Stage Vacuum Ejector with jet intercondsener between stages



Type "C"
Combination Two-Stage High Vacuum Ejector with surface inter- and after-condenser.

Elliott-Ehrhart Air Ejectors

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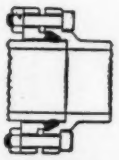
SIMPLEX CAST IRON CONDENSER PIPING



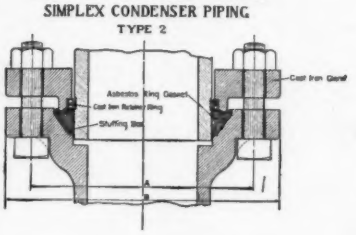
"ONE FLANGE IS LOOSE"

Settles the Rust Question

Progressive refineries now secure the durability of cast iron pipe in their condenser coils without the disadvantage of standard flanged pipe construction. Our Simplex joint, using a triangular shaped, endless asbestos gasket, is the secret. It is fully described and illustrated in our Catalog No. 55. Your copy is ready to be mailed upon receipt of your request.

Do you know why cast iron resists corrosion so much more than other ferrous metals? Our Bulletin No. 44 explains it.

CROSS SECTION OF ASSEMBLED JOINT
SIMPLEX CONDENSER PIPING
TYPE 2



Dimensions A and B are American Standard for 125 lbs. pressure

AREA PER LINEAR FOOT

SIZE	CLASS	INSIDE SQ.FT.	OUTSIDE SQ.FT.
3"	AB	.67836	.101.75
3"	CD	"	.106.72
4"	A	.16472	.1.7900
4"	BCD	"	.1.31150
6"	A	1.37108	.1.86.50
6"	BCD	"	.1.85.70
8"	AB	.3.28968	.2.3440
8"	CD	"	.3.44.60
10"	AB	.3.6200	.3.2100
10"	CD	"	.3.29900
12"	AB	.3.4618	.3.6600
12"	CD	"	.3.5600

Write for Simplex Condenser Catalog Number 55

AMERICAN CAST IRON PIPE COMPANY

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York,

Write Also for information on Our Prepared Joint Cast Iron Pipe for Oil Lines

EMPIRE 720
Absorption Oil

has been the Standard for Quality and Long Service ever since the establishing of Natural Gasoline Plants in the Mid-Continent and it has kept abreast with the developments through exacting control in the Empire Laboratories and Plants—by holding Quality and Uniformity above Costs in its manufacture.

CITIES SERVICE OILS

EMPIRE REFINERIES INC.

SUBSIDIARY CITIES SERVICE CO.
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A portion of the Smith mechanical laboratory. Here the steel for Smithsteel Pressure Vessels is subjected to searching tests to insure its meeting the standards demanded by Smith engineers

STEEL— *of Highest Quality Makes Smithsteel Stills Better*

Pressure vessels are built to the demands of the industry as large as needed, of any wall thickness to withstand any specified pressure to meet all operating conditions. Smith methods of manufacture have placed at the disposal of the oil industry cracking stills that permit full utilization of modern refining processes.

Fully appreciating the stresses imposed by high temperature and pressure, Smith engineers place special emphasis on steel quality. In the Smith laboratories the utmost care is taken to insure highest quality in the metal that goes into Smithsteel Cracking Stills.

Chemical analysis alone does not satisfy the Smith Standard. Actual Physical tests in the fully equipped mechanical laboratories at the Smith plant determine finally the fitness of the metal.

Precautions such as these follow through the entire manufacturing process. They make certain that each pressure vessel that leaves the Smith plant is a worthy addition to the Smithsteel Cracking Stills that are now setting new efficiency records in the industry.

Any Wall Thickness Required

Smithsteel Pressure Vessels can be built in any wall thickness, in any diameter and of any length, to withstand any specified pressures to meet all operating conditions.

A. O. SMITH CORPORATION • *Milwaukee, Wisconsin*
TULSA • LOS ANGELES

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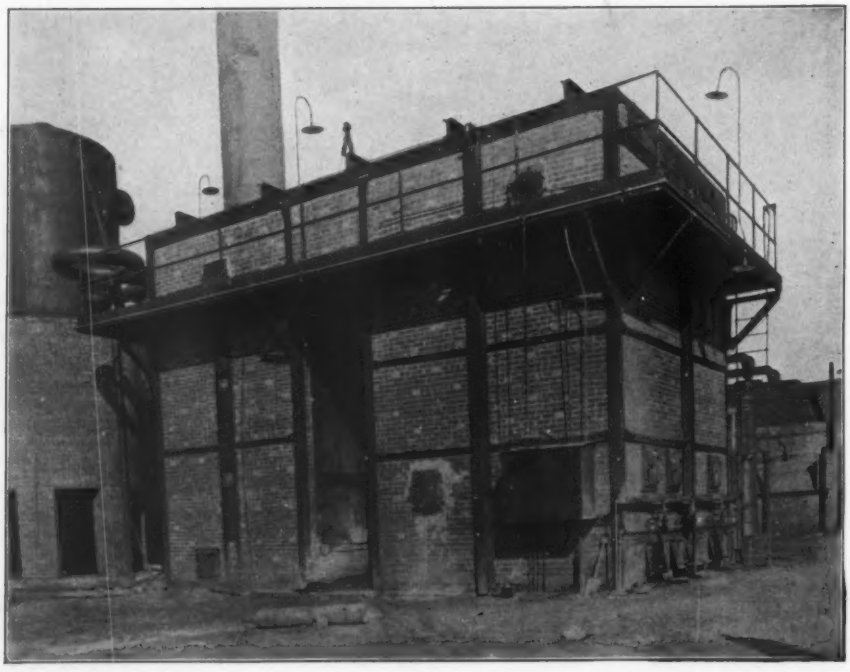
FOSTER

TUBE STILLS



Successfully take an overhead of 90% of the throughput without cracking. In over 400 installations Foster Stills are obtaining greater yields of overhead distillate with less fuel consumption than is possible with older types of equipment.

POWER SPECIALTY COMPANY

111 Broadway, New York

Branch Offices in All Oil Centers

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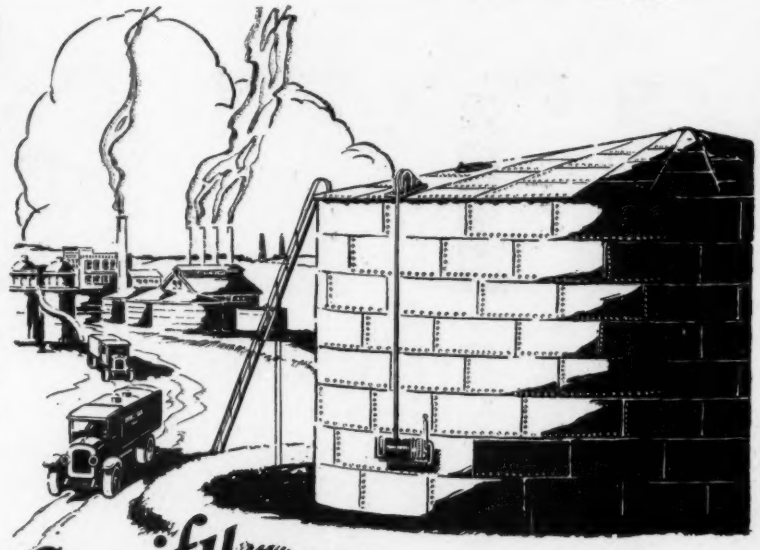

Specify OCECO Fittings for that new tankage!

MAKE sure of enjoying lowest maintenance and operating costs—of gaining protection against evaporation and fire by having your tanks "Oceco equipped".

Progressive tank manufacturers are pleased to quote on Oceco Equipment because it makes a *good* job *better*. Consequently, several of them supply Oceco as standard equipment. Others furnish it as optional. On tanks already built many oil companies purchase direct, installing it themselves.

More and more, producers, refiners and marketers realize that their investment in this high grade equipment yields handsome dividends by the savings it effects; yet Oceco costs little, if any, more than ordinary equipment.

Send for the late Oceco catalog

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325 Iowa Building, Tulsa, Okla.
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Neilan, Abbey & Co., Los Angeles, Calif.
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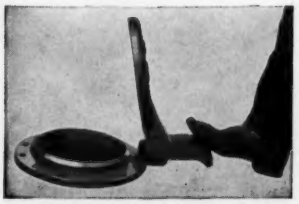
Roof Manholes



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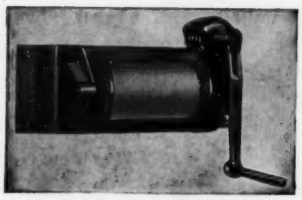

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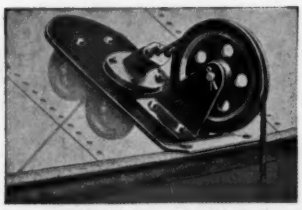


Cable Sheave Brackets

Swing Joints

Steel Tank Nozzles

OIL TANK **OCECO** EQUIPMENT
SAVES EVAPORATION AND PREVENTS FIRE

Outstanding Features The Matthews Gun

1. Matthews Air Envelope. Minimizes fog and mist.
2. Only one nozzle and one sleeve for all materials.
3. Spot the size of a dime to 12 inch stroke.
4. Easy to clean without taking apart.
5. Fewer parts. No needle valve.
6. All aluminum body.

Save 40% to 70% In Painting Costs

See just how oil companies everywhere are saving thousands of dollars annually on their cost of painting bulk stations, tank cars, cracking units, refineries, buildings, and all company properties. Matthews Mechanical Painting Equipment now enables one man to do the work of four to eight hand painters. Where oil companies have been spending 65% of their maintenance painting money for labor and 35% for material, they tell us that now, using Matthews Mechanical Painting Equipment, the proportion is but 25% for labor and 75% for material. Hence with a given appropriation Matthews Mechanical Painting Equipment will enable you to paint from 2 to 3 times more surface. The exclusive features of the Matthews Paint Gun eliminate waste and remove the objectionable features of ordinary spray painting methods. See just why maintenance men, after critical tests, discard other methods and equipment and choose

MATTHEWS
MECHANICAL PAINTING
EQUIPMENT

Write for Bulletin "Mechanical Painting for Industrial Maintenance"

W. N. Matthews Corporation
3784 Forest Park Blvd., St. Louis, Mo.

Making Good the Guarantee

Williams Double-Disc Gate Valve No. 127—representing the height of valve service. Ask your dealer for it

No effort to shirk responsibility! No grumbling over severity of the service demanded! No "ifs or ands" or quibbling of any nature!

Service at a profit! That is the plainly understood proposition on which all **Williams Valves** are sold. Discriminating valve buyers know the **Williams** saves coal, labor, time and trouble, and assures uninterrupted production. Profits from such service are incalculable.

Williams Double-Disc Gate Valve No. 127

is one of the peerless **Williams** line that is famed for abolishment of all waste—for the insurance of a full, steady and leakless flow of Air, Steam, Water, Gas or Oil.

A tight seat is assured by the ball and socket bearing discs that also compensate for any temperature distortion or sagging of pipe lines.

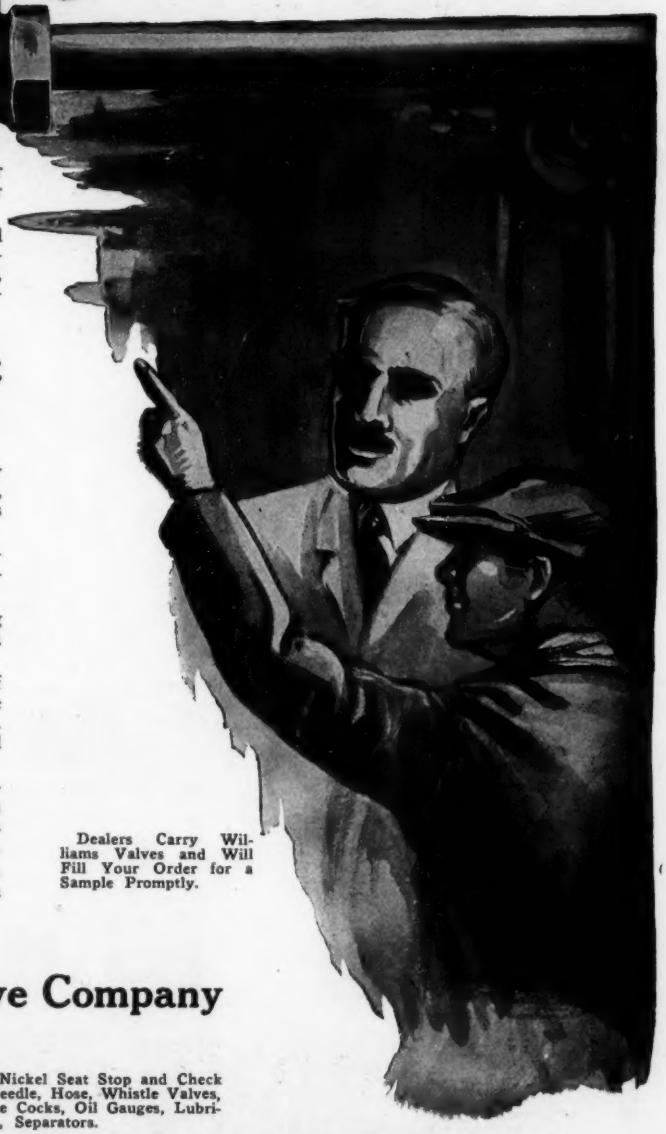
An **exclusive** Williams feature is the Union Ring method of securing the bonnet to the body, providing a rigid, steam-tight joint that cannot corrode.

The heaviest stem used in any gate valve—made of special hard bronze that will not bend or break. Acme Standard threads assure maximum wear and long life. Packing is forced against the stem by a Packing Gland Follower.

Many other features that explain the extremely satisfactory service of Williams Valves are described in our Catalogue 10. It clearly explains why Williams Double-Disc Gate Valve No. 127 always makes good.

Made in two patterns—Medium for 200 lbs. pressure and Extra Heavy for 350 lbs. pressure. **Satisfaction Guaranteed.**

Catalogue No. 10 mailed on request.



Dealers Carry Williams Valves and Will Fill Your Order for a Sample Promptly.

The D. T. Williams Valve Company

Cincinnati, Ohio

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Valves

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SUNOCO

Absorption Oil 670 and 630

This oil is manufactured especially for Natural Gasoline Plants.

By its uniformity in boiling range and recognized superiority by many of the foremost Natural Gasoline Manufacturers, SUNOCO ABSORPTION OIL more and more is coming into a wider demand.

SUNOCO ABSORPTION OIL actually does reduce overhead costs in plant operation and increases yields of natural gasoline over other oils.

May we have an opportunity to prove this statement to your satisfaction?

Samples and Quotations Cheerfully Furnished on Request

SUNOCO

SUN COMPANY

District Office:
TULSA, OKLAHOMA

Refineries at
Marcus Hook, Pa., Yale, Okla.
Toledo, Ohio.

No more buckles!

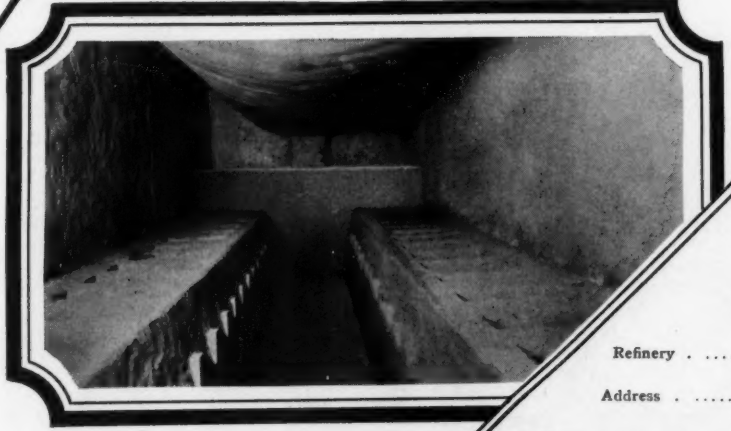
YOU can end the menace of buckling stills. The Plibrico Diffusing Furnace positively prevents overheating. We'll gladly send one of the Plibrico engineers to tell you about it.

Send the coupon.

This furnace ends them

PLIBRICO JOINTLESS FIREBRICK COMPANY

1165 CLAY STREET, CHICAGO
Factories: Chicago and Trenton, N. J.



This is the interior of a Plibrico Diffusing Furnace. Flame does not come in contact with the still bottom; it is confined to the "dog-house" type combustion chambers. Heat is evenly distributed over the entire still—no more cracking, no more still bottom failure.

Coupon

Send the engineer

Refinery .....

Address .....

My Name .....

To Plibrico Jointless Firebrick Co.,
1165 Clay Street, Chicago, Ill.
RNGM 6-GRAY

Mention Where You Saw the Advertisement

MIDWAY'S VENTURA PLANT BUILT WITH COOPER ENGINES

FROM an engineering standpoint, Midway Gas Company's Ventura Station could well serve as a model for practical compressor station layouts.

It contains twelve 170 B.H.P. Cooper Type-80 Gas Engines direct driving Cooper compressors.

These engines are of the four-cycle type. They have been making friends in the California fields because of their fuel economy and greater reliability.

THE C. & G. COOPER COMPANY

HOME OFFICE, MT. VERNON, OHIO

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and NATURAL GASOLINE MANUFACTURER
EDITED MONTHLY AT TULSA, OKLAHOMA
GRADY TRIPLETT, *Editor*
Published by
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HOUSTON, TEXAS
R. L. DUDLEY, *President* A. L. BURNS, *Gen'l Mgr.*
Vol. 5 JUNE Number 6

For men engaged in the operating branch of the refining and natural gasoline business

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Suitable Laboratory for Refinery of Modern Size

Laboratory and equipment at Parco selected to meet requirements at that plant

By H. L. Kauffman

THE refinery executive upon whom depends the routine control and research and experimental policies of a company encounters many problems—financial and otherwise—in deciding how much money shall be expended for laboratory purchases and how the laboratory and its personnel shall be arranged and organized so as to function to best advantage.

The larger companies, as a rule, have definitely specified policies concerning the operation of their chemical research and development organizations; they appropriate a definite sum each year for maintenance, and follow a general policy to the effect that, if the results are not of sufficient value to pay for the cost of such work this year, a financial benefit will be obtained either next year, or the next year, or the one following, or at some future time. In other words, a so-called "waiting policy"—with faith on the part of the executives unshaken if no immediate or great financial benefits are obtained as a result of the large sums of money expended in such work.

P. & R. Plan

How one company, Producers and Refiners Corporation, met this problem in providing laboratory facilities at their Parco, Wyo., refinery is to be discussed in detail in this article. Particular emphasis will be placed by the writer upon the construction and layout of the combined laboratory and office building, and the arrangement of the equipment, more especially so in view of the fact that the work and the conditions encountered at this refinery are typical of what is met by other refiners operating plants of similar size. Hence, from this detailed description of the Parco refinery laboratory it is believed that ideas will be obtained by refinery executives and chemists, in general, that will prove of advantage, if adopted, perhaps with modifications, in their own particular refinery laboratory.

Determining Size of Laboratory

The construction of this refinery, which was started by the company's own engineering department, was turned over to the J. G. White Engineering Corporatoin of New York, in February, 1923; while, at the same time, a definite decision was reached to increase the size of the plant, over that originally contemplated, to one of 10,000 barrels daily capacity—same to include a unit for the manufacture of lubricating oils.

These plans for building a refinery of larger size and for installing a lubricating oil manufacturing unit made it necessary to give consideration to the construction of a combined laboratory and office building of larger size and at a different location from the one already built—this because of the fact that the laboratory originally built was located on the site desired for the lubricating oil plant. Although tentative plans for the new laboratory and office building had been made during the latter part of 1923, it was not until May, 1924, that the final plans were approved and construction work on the building was actually begun. In the meantime—in April, 1924, to be exact—the old laboratory building was razed in clearing the site for the lubricating oil plant, and from that time until November, 1924, when the new laboratory could be used, the laboratory functioned as such in a temporary frame structure located close to the building under construction.

Central Location Necessary

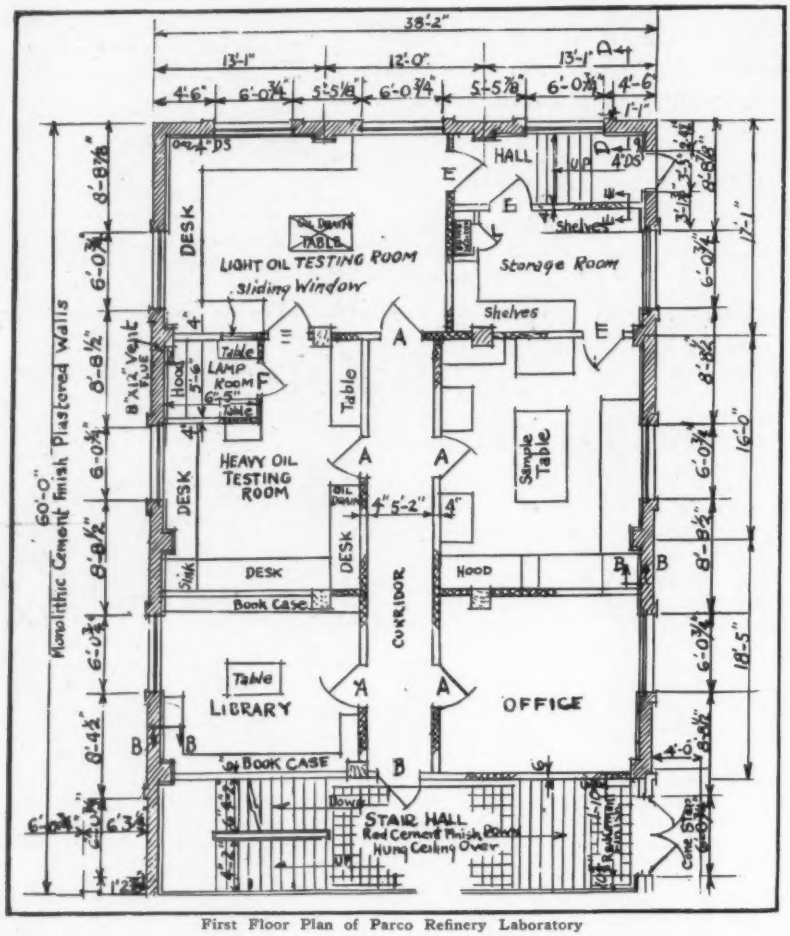
In planning any laboratory, first thought should be given to seeing that it is centrally located, and hence can be reached conveniently and quickly from all the different manufacturing units.

Another consideration that had to be given to the planning of this particular laboratory and office was whether or not a separate building should be constructed, or whether it would not prove of greater advantage to make the laboratory an annex of one of the buildings of the lubricating oil manufacturing department. Because of construction economies that could be effected and because it would make possible the convenient expansion and enlargement at any time of that particular unit to which it was attached, it was finally decided to make the laboratory and office building a "wing" of the compounding and filling house building of the lubricating oil department. This arrangement makes possible changing the space now occupied by the laboratory and plant offices, with little difficulty, at any time, into an addition to the compounding and barrel house where, if so desired, equipment for placing lubricating oils in cans could be installed—a thing that is not now done. For this last reason, therefore, this laboratory and office "annex" was particularly well constructed and reinforced in order that the different floors could well withstand the weight of any heavy can-filling equipment that might be used in the building at any future time.

Size of Laboratory

The next point under consideration in planning a laboratory is its size. In every instance, thought must be given not only to providing suitable facilities for handling with maximum efficiency the present work, but there should also be anticipated an increase in the amount of work as a result of any expansion in the size of the refinery.

Fifteen important and different features were involved in deciding the most efficient size, arrangement and



First Floor Plan of Parco Refinery Laboratory

equipping of the laboratory needed to take care of present and future requirements of the Parco refinery. Briefly, these main features, which were considered in planning this laboratory, were as follows:

1. To provide a separate room of suitable size for the testing of light oil samples, such as gasoline, kerosene, pressure distillate, prime white distillate, etc.

2. To provide a separate room of suitable size for the testing of heavy oil samples, such as fuel oil, crude oil, lubricating oil, gas oil, etc.

3. To have such testing rooms easily accessible to each other so that, if shift work at any time is necessary, one man can take care of the work in both rooms with a minimum of effort.

4. To have a small room of suitable size, built within a room, readily accessible from both the light and heavy oil testing laboratories, in which room flash and fire tests and lamp burning tests can be made.

5. To provide a separate room of suitable size as a chemical laboratory, with a graduate chemist in charge of and responsible for same, in which room is to be handled such analytical and laboratory research and experimental work as may be necessary in connection with the efficient operation of the refinery, and which work is of such character that it can be handled in a small room of this general type.

6. To have such chemical laboratory easily accessible from both the light and heavy oil testing laboratories.

7. To provide a storage or stock room of suitable size for keeping in orderly arrangement all supplies of chemicals and glassware.

8. To have such stock room easily accessible from both the chemical and the light oil testing laboratories; as well as close to an outside entrance, so that incoming supplies can be handled and unpacked with a minimum of effort.

9. To have both a rear and a front entrance to the laboratory, so that unnecessary steps on the part of sample boys, stillmen and others having business in the laboratory, will be as few as possible.

10. To provide suitable office facilities.

11. To provide for the expansion of the laboratory, if at any time such expansion becomes necessary.

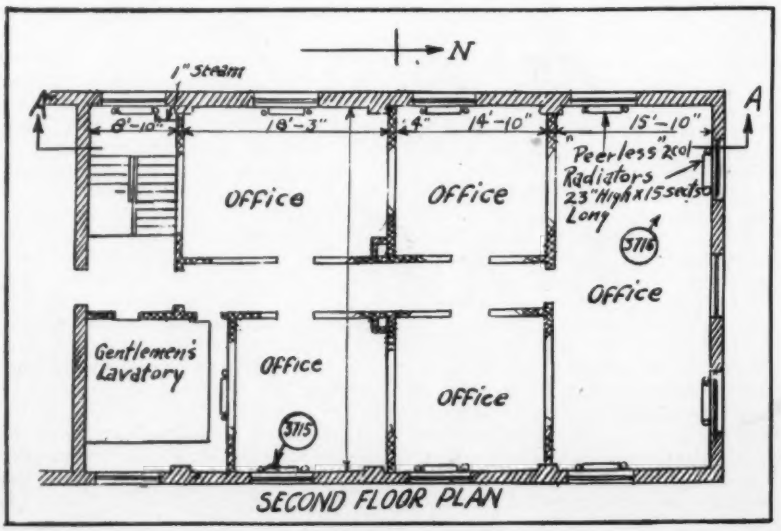
12. To provide a suitable place for the storage of retired samples of shipments.

13. To provide a suitable place for the washing, drying and storage of sample bottles.

14. To provide a research and experimental laboratory of suitable size, where quantities can be handled on a larger scale than in the chemical laboratory.

15. And, lastly, to furnish and to equip all rooms so that every possible facility will be available for conducting the work with greatest efficiency; and, at the same time, to have all rooms neat looking and attractively furnished, so that the visitor will be favorably impressed at the exactness with which all products are tested—in other words, to make the laboratory, for the visitor, at all times the "show room" of the refinery.

How the above features were included in this laboratory are better understood by a study of the accompanying sketches, these being sketches of the first floor and basement of the Parco refinery laboratory and office building. Minor changes and additions to the equipment in the different rooms have been made at various periods of time, but, in general, the size and relation of the



rooms, halls, doors, etc., to each other are as indicated in these Figures.

It is to be noted that the laboratory building proper is, approximately, 38x51 feet in size, and that six rooms—exclusive of the flash and fire, or lamp room, as it is also called—are located on the first floor.

Light Oil Laboratory

The light oil testing laboratory is a room, approximately, 15x21 feet in size and is located in the northwest corner of the building. This room is provided with two large windows on the north and a window of the same size on the west. Three doors open into this room, one from the hall that provides a rear entrance into the laboratory from the northeast corner of the building; a second from the main, central hall of the laboratory building; while a third door connects the light and heavy oil testing laboratories.

The heavy oil testing laboratory is a room, approximately, 15x20 feet in size and is located in the west-central portion of the building. In the northwest corner of this room is built a small room 5 feet 6 inches by 6 feet 5 inches, in which room flash and fire tests are made. The only other door into the heavy oil testing laboratory—in addition to the door connecting it with the light oil testing room—is the door that opens into this room from the main hall.

Opposite the heavy oil testing laboratory is a room, also 15x20 feet in size, which is used as a chemical laboratory. The chemical laboratory is adjacent to and is connected by a door with a room approximately 9x15 feet in size, that is used as a stock room for the storage of chemicals and glassware. Another door also opens from the stock room into the rear hall.

In the southeast and southwest corners of the building are two rooms, each approximately 14x15 feet in size. The southeast room is used as an office by the chief chemist; the southwest room was originally planned to provide facilities for laboratory expansion, if necessary at any future time. However, at the present time, this room has been fitted up and made into a First Aid room and as such it is now being used under the direction of one of the laboratory employes, who handles all necessary first-aid work in addition to his regular laboratory duties.

Use of Basement

Entrance into the basement is provided by steps leading down from the hall connecting the laboratory and office "wing" with the main compounding and barrel house.

Four rooms in this basement are available for laboratory facilities—the fifth being used for housing the pumps and manifolds of the compounding building.

The first room entered in the basement is 18x18 feet in size, and, originally, was planned as a locker and dressing room for employes working in all parts of the building and was to have been provided with showers, lavatory, etc. Because of the impracticability of providing drainage facilities, this plan later was abandoned and showers and lavatory for employes were located on the third floor of the building. This room is now used, for the most part, for conducting treating experiments, and hence is fitted up with a 1-barrel agitator, a 10-gallon agitator, together with other miscellaneous laboratory equipment.

Heavy Oil Testing Room P. & R. Laboratory

Two doors leading from this 18x18 foot room just mentioned—one on the left leading into a room, approximately 12x30 feet in size, used as an experimental laboratory; the other, on the right, leading into a room 10 feet 6-inches by 24 feet, which is fitted up with shelves for the storage of retained samples of shipments. From this sample room, another door leads into the fourth room in the basement—a room 21x24 feet in size—which, for the most part, is used for the washing, drying and storage of empty sample bottles. However, this room is also fitted up with desk facilities, so that, when occasion warrants, research and experimental work can be conducted therein. A door connects this room with the main basement experimental laboratory.

For the convenience of the sample boys in transferring samples and bottles from the testing laboratory, a dumb-waiter was installed. This waiter opens out into both the stock room and the light oil testing laboratory on the first floor, passing on down to a conveniently located point in the so-called "bottle - washing - and-drying-room" in the basement.

Refinery Offices

Five office rooms were provided on the second floor of the combined laboratory and office building at the Parco refinery. Connecting doors have since been provided between the southeast and the southwest rooms and the respective center rooms immediately adjoining. At the present time these offices are occupied by the following refinery executives or departments:

Southwest room—Secretarial office nd entrance to superintendent's office.

West-central room—Refinery superintendent's room.

North room—Engineering and drafting department.

Southeast room—Process superintendent's office.

East-central room—Plant foremen's office and foremen's meeting room.

The yield and accounting offices of the refinery at one time were located on this floor, but these were removed and transferred to a building outside the refinery proper, when there took place a consolidation of all work of such nature from the refining and production departments of Producers and Refiners Corporation.

Miscellaneous Features

The second floor is provided with wood flooring. All of the first floor and basement, however, is of concrete. An effort was made to have all concrete floors pitched to floor drains, so that they would drain readily when the place was being washed up. This was done, particularly in the basement, as no floor drains were provided on the first floor.

All tile partition walls in the basement consist of 6-inch, hard burned, terra cotta partition tile—glazed on

(Continued on page 38.)

Specifications for Efficient Laboratory Air-Pressure Filter

DURING the last ten years and more especially durnig the past five years, there has been an increased interest in and a demand for an efficient, easily-handled laboratory air-pressure filter for use, especially, in petroleum refinery laboratories.

This need has been occasioned, largely, by the research and experimental work—and during the past three years, in many cases, because of actual control work—being done by nearly all petroleum refiners on problems involved in the so-called "contact filtration" of oils; that is, the method wherein a finely-divided clay or a clay-pulp is applied to an oil, the whole heated, and the fine clay thereafter separated from the oil by any suitable means.

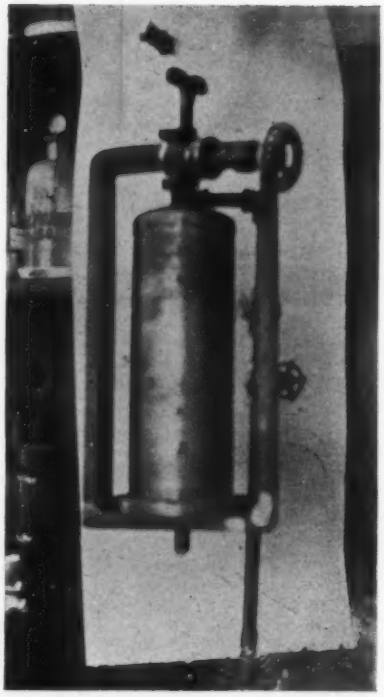
As an immense amount of research and experimental work is needed—and is being done—in connection with the development of this process, it is self-evident that any means for quickly separating the oil from the clay, when conducting laboratory work along these lines, will save time for the chemist or laboratory worker—and time means money.

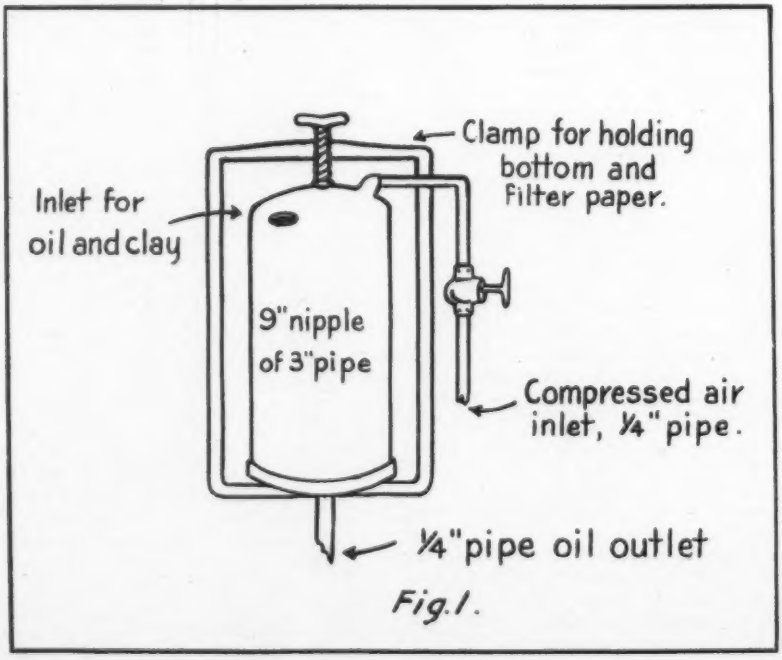
Vacuum Slow

Vacuum filtration, the vacuum being produced either from an air or a water jet or from a vacuum pump, does not prove rapid nor entirely successful. Furthermore, this method has the additional objection that not as dry an oil-clay cake can be obtained; and hence, since, in plant operation, pressure filters are used most frequently, separation of the clay from the oil-clay mixture in the laboratory by vacuum filtration does not give results—at least in so far as the nature of the cake is concerned—that duplicate plant practice. On the other hand, with a laboratory air-pressure filter, and either knowing definitely, or being able to regulate, the air pressure on the line, it is possible to get as dry a cake in the laboratory as in the plant, and hence fairly accurate laboratory results as to yield, loss of oil in cake, etc., can be obtained—such results duplicating closely the results obtained in plant operation.

It might be mentioned also, that laboratory work that is being done, wherein use is made of the pressure filter of the type to be described herein, includes such work as determining the decolorizing efficiency of clays under such conditions as follows:

1. Raw clay, determining the efficiency of the clay on different oils, when the clay has been ground to various degrees of fineness, such as, 100-mesh, 200-mesh, etc.
2. Treated clay; that is, clay that has been treated with sulphuric, or other, acid and thereafter either washing out or not washing out the products of the reaction, and applying the treated clay to the oil either after the clay has been dried or without any subsequent drying after treatment; but instead, applying the same to the oil in the form of a wet-clay pulp.
3. Determining the efficiency of either raw or treated clays under various temperature conditions; that is, ascertaining the temperature at which a maximum decolorizing efficiency is obtained.
4. Determining the efficiency of either raw or treated clays under conditions wherein the time of contact of the oil and clay is varied; and noting, also, the efficiency when variations are made both in the time of contact and in the maximum temperature reached.
5. Determining the efficiency of the clay in the presence of chemicals that are either of a catalytic nature or that actually enter into the reaction.
6. In carrying out research and experimental work involved in treating used clay so that it can be re-used.
7. In the routine control of the filter house when the contact method of filtration is used.
8. In obtaining data concerning the oil-retentive powers of the clay; that is, information relative to the amount of oil that would be lost in the clay if the particular clay being tested were used in the plant, and similarly related yield data on different clays and under varying conditions.




Clamp for holding bottom and filter paper.
Inlet for oil and clay
9" nipple of 3" pipe
Compressed air inlet, ¼" pipe.
¼" pipe oil outlet
Fig. 1.

The above represents just a few of the numerous occasions when a suitable laboratory air-pressure filter proves of use in contact filtration work alone—not to mention the many other uses for which it proves to be of particular advantage in the laboratory.

It is not to be inferred by the reader that the particular air-pressure filter that will be described in this article is the most convenient and satisfactory of all pressure filters of similar type that are used in many petroleum refinery laboratories. But, it does represent the design of a filter that has been used for nearly three years in the laboratory of Producers and

Refiners Corporation's Parco, Wyoming, refinery—and, for a home-made piece of equipment (it was made in the refinery welding and machine shop,) it has proved both suitable and satisfactory.

Construction

The filter consists of a 9-inch nipple of 3-inch pipe. It is machined smooth on all inner surfaces. The nipple is welded shut over one end, bulging outward, and a depression is made in the center thereof for retaining in place the lower portion of a thumb-screw, which latter is used—together with a clamp—in holding in place the bottom plate. The barrel of the filter is further provided with a ¾-inch opening, which serves as an inlet for pouring into the filter the oil-clay mixture; and another opening—¼-inch in size—serving as an inlet for the compressed air.

A bottom plate, to which is welded fast a ¼-inch oil outlet pipe, a clamp and thumbscrew, the barrel of the filter proper, a wire gauze and filter paper, together with air line and valve constitute the essential parts of a suitable air-pressure filter.

A slight depression in bottom (machined out and made perfectly smooth) for holding a 9-cm. filter paper. The opening in the bottom of the plate is ¼-inch in size. A ¼-inch in diameter nipple, about 4-inches long and cut off at an angle, is welded to this bottom plate. A wire screen is placed over the opening in this plate, in using the filter, and over this then is placed the filter paper. After the oil and clay-mixture has been poured into the filter, the oil-inlet opening is closed. The compressed air is then turned into the filter and the pressure allowed to build up slowly until the cake has started to form over the entire surface of the filter paper, after which the full pressure of the air line can be turned into the filter with little danger of a tearing of the filter paper taking place.

The oil inlet may be equipped with a plug, a pet-cock or, better yet, a ¾-inch gate valve. A gate valve is used in the particular filter being described. When it is desired to use the filter in separating clay from oil, a funnel is inserted in the gate valve, and the oil-clay mixture then poured into the filter through this funnel. The air pressure inlet is ¼-inch in size, and, at the Parco refinery, is so connected with a ¼-inch pipe that the pipe itself serves to support, and to hold upright, the filter. A needle valve is placed in this air line at a convenient point near the filter.

Laboratory Control of Boiler Water Conditions

By Ralph E. Goode

IN the last few years, more especially among Mid-Continent refiners, the laboratory has come to hold a very important place. There are various reasons for this, chief among them being the economic. Competition demands it as well as sound reasoning. No refinery operating successfully now can get along without a well equipped laboratory with competent men in charge constantly checking and analyzing products with quality and quantity the uppermost factor. The laboratory is as essential to the modern refinery as the throttle is to a locomotive. A very significant and important part of the labcratory assumes in plant operation is keeping a constant check on boiler feed water. This very important element is in a great number of instances a source of worry and trouble, causing financial loss to the plant, increasing expenses and acting as a general detriment to operation. Modern industry progresses as much by reducing failure as by increasing production, and the laboratory does both.

Steam is a force that has had a very useful part in the progress of man, and it is employed extensively in the refining of crude petroleum. The quality of the steam produced and the amount is very essential to the plant's product with some methods of operation and keeping the boilers at their highest efficiency is a part of the laboratory's every day job. We know that boilers are susceptible to scale and corrosion and that a proper knowledge of the cause will aid in the prevention of coked boilers and corroded feed lines. We know that it takes more heat to raise the temperature of water a given amount than any other known substance. It has the greatest capacity for heat. Mercury, a very commonly used substance, has only 1-30 the heat capacity of water. The specific heat of water is 1, and it follows that the specific heat of other substances is less than 1. The calorie is the unit of heat quantity, and 1 calorie of heat must be furnished for every gram of water present in order to raise it 1 degree Centrigrade. In order to heat 1 gram of water from 0 degree Centrigrade to 100 degrees Centrigrade it will require 100 calories of heat. So in order to change 1 gram of water at 100 degrees Centrigrade to steam it will require 537 calories more of heat. The absorbing of 538 calories of heat in converting 1 gram of water into steam is called the "Heat of Vaporization of Water."

Universal Solvent

History tells us the ancient alchemists were constantly searching for a "Universal Solvent." Water comes very near to this. To some extent all substances are affected by it, and for this reason natural waters are never pure. Sea water contains a very large quantity of matter in solution calculated at 3.6%. The greater part of this being sodium chloride. (Salt.) When water is tested for drinking purposes it is nearly always tested for nitrates and ammonia. These substances are not altogether harmful in themselves, but they are generally absent unless the water has been polluted by organic matter. Water when flowing beneath the earth's surface or on the surface invariably takes up some of the constituents of the rockbeds it passes over. This water can contain a great number of different salts, but in small quantities.

There are two classes of these compounds which we find to be very objectionable and which will deposit scale in boilers. They are the compounds of magnesium and calcium. The principal salts which make water "hard" are the chlorides, sulphates or bicarbonates. It is a well known fact that hard water has a very damaging effect on boilers because of the dissolved salts that remain inside after evaporation, and that scale or coke is formed on the metal. These salts are constantly being deposited during evaporation in layers until the deposits sometimes reach a thickness of several inches. Naturally there is a great fuel waste in penetrating with heat this thick coke, and there is also danger of blown boiler tubes or an explosion due to the inequality of heat distribution, the thick scale may suddenly crack with disastrous result. With coked boilers it is next to impossible to maintain pressure necessary to the production of dry steam. Pure steam is a dry, transparent, colorless and an invisible substance. Only when it is seen in contact with air is it visible, because of the partial condensation. A dry steam can not contain free moisture, and it may be saturated or superheated. Wet steam has free moisture in the form of mist, and ordinarily has the same temperature as a dry saturated steam with the same pressure. Normal steam is saturated and its temperature is the same as the water from which it is generated. Superheated steam is steam that is above that, due to its pressure after leaving the water from which it is made, because of again being heated from another source.

A volume of water evaporating at

760 millimetres pressure (normal) and at a temperature of 100 degrees Centrigrade, becomes 1646 volumes of steam, a cubic foot of water will increase to 1646 cubic feet, and so on.

Need of Pure Water

A well designed boiler with proper knowledge of firing conditions, draft, etc., should evaporate 20 pounds of water to each gallon of fuel oil. If it were possible to always get pure water suited to boiler requirements for making steam, then it would be altogether the design and firing to be taken into consideration, but nature has ways of her own, leaving it to man's ingenuity to devise means whereby he may rid himself of objectionable things. There are a number of methods of treating water for boilers, and a number of compounds advertised as being especially valuable, but for getting around successfully without the use of soda, ash and lime is a hard matter.

A very successful method of treating has been evolved where the salts of magnesium and calcium are very objectionable in the water, the water being extremely hard. It consists in preheating the water to 180 degrees Fahrenheit and treating in 1000-gallon cylindrical tanks containing revolving stirrers with caustic, soda ash and lime. Water with a hardness of 45 grains is given a treat of 1.15 pounds caustic, 1.07 pounds soda ash and .940 pounds lime per 1000 gallons of water. The water being at a temperature of approximately 180 degrees Fahrenheit at the time of treatment. Fifteen minutes generally suffices for precipitation. The cost of this treatment will average under ordinary conditions $0.11200 per 1000 gallons of water. A loss may be expected of about 5%, due to safeguarding against sedimentation and 1.5% in clearing tank connections and suctions of any precipitate which may drift into them. Also some water (untreated) will be required for washing the tanks. An analysis of a sample of water showed the following:

Mineral	Grains per Gallon
Silicous matter	0.65
Iron and aluminum	0.40
Calcium sulphate	1.20
Magnesium carbonate	2.45
Sodium and potassium carbonate	4.45
Sodium and potassium sulphate	34.55
Sodium and potassium chlorides	51.42
Incrusting solids	4.70
Non-incrusting solids	90.55
Total solids	95.25

At this particular plant no less than six different compounds designed for any and all water have been tried with varying success, but nothing as satisfactory as caustic soda, soda ash and lime has been found.

Laboratory Essential to Quality Product From Natural Gasoline Plant

By W. R. Lentz,
Chemist Chestnut & Smith Corporation

DURING the early history of the natural gasoline industry the relationship between the natural gasoline plant and the laboratory was given very little consideration. At that time, there were practically no laboratory test methods that were adaptable to natural gasoline and, due to the primitive methods of manufacture, the product made and shipped was of a very volatile nature.

This condition allowed the plant operator to put all of his efforts into making as large a gross production as possible with practically no thought as to the quality of the product. One can readily see why the laboratory played so small a part in the natural gasoline industry at that time. If the product shipped came within the vapor tension limits allowed by the shipping regulations, the only other tests necessary were gravity and endpoint.

The tremendous growth of the natural gasoline industry and the increasing demand for better grades of natural gasoline has completely changed the operating conditions to a point where the quality of the natural gasoline manufactured is of equal importance with the quantity.

This condition has made it necessary for the plant operator to take a great deal of interest in the efficiency of plant operation and also has caused a well equipped laboratory to be an absolute necessity in order to co-operate with the plant in gaining this high efficiency of extraction and still maintain a quality which will reduce the loading loss to a minimum.

The principal industries of today have found that a technical department is necessary in order to maintain efficient operation and so, as the natural gasoline industry expanded, the need of the laboratory became more urgent until today all of the leading natural gasoline companies depend upon the laboratory to assist in producing the maximum quantity of marketable gasoline at a minimum cost.

Co-operation Essential

It is evident that plant problems must first be solved in the laboratory and then applied to plant operation. Co-operation then is the only key to success in the manufacture of natural gasoline. A man without the spirit of co-operation is a detriment to his fellow workers and to the company for which he works. Neither the laboratory nor the plant can function properly without the assistance of each other.

The laboratory force of a natural gasoline plant should not be entirely subordinate to the plant superintendent. They should both receive their authority from the head office. One funtion of the laboratory must be to test the product made by the plant. One must check the work of the other. Therefore, neither should have absolute authority over the other. They should occupy co-ordinate positions, neither subordinating itself to the other.

A man, to be a good plant aoperator, should have some knowledge of practical laboratory test methods. This same rule should apply to the laboratory man regarding plant operation. The best way to acquire this knowledge is by co-operation between the laboratory and the plant. A man's thirst for knowledge should not be considered altogether for his selfish gain but rather to enable him to be of more service to the company for which he works.

No Place for Envy

One of the things that will disrupt an organization is envy among the men. A man may be envious of another man's position or of his ability. Either instance is a detriment to an organization. How can a department function properly or co-operate with another depatment when a noticeable amount of envy is allowed to creep into the every day work? Often time, a man may be slightly jealous of another man and still be able to co-operate with him in all things but more often it is just the opposite.

Jealousy will sometimes cause a man to put a greater amount of effort and study into his work in order that he may acquire that for which he may be jealous. But, to keep complete harmony among the men and to acquire the maximum amount of co-operation, the men in the different departments must always have the interest of the company for which they work as their main object in view. In this way envy and jealousy will be kept down to a minimum.

Braun Opens Dallas Office

Dallas, Texas.—C. F. Braun & Company have recently announced the opening of a sales and engineering office here with headquarters in the Republic National Bank Building. Preparations have been made by the Dallas office to make engineering surveys and submit quotations on Braun products, according to A. W. Burket, manager of the Mid-Continent office at Tulsa. The Dallas office of the Braun company is under the management of V. V. Jacomini, who opened the office for business May 1.

The Anti-Knock Properties of Cracked Gasoline*

Gustav Egloff
Universal Oil Products Co.

THE conservation of our power potential is an ever-increasing problem in our economic life. This power potential may be in the form of water, coal, shale, crude, petroleum, fuel oil, natural gas, or gasoline. One of the outstanding power potential conservations is that of the cracking process for the conversion of oils into gasoline. Not only is the cracking process conserving as a minimum 500,000,000 barrels of crude oil a year, but it is producing a gasoline of anti-knock properties suitable for high-compression motors.

The cracking process is not alone conserving potential power in saving crude oil and producing gasoline, but is also bringing about large economies in the refining operation by eliminating crude oil and coking stills. This is due to the fact that the cracking process as developed may simultaneously, in the same installation, distill off normal gasoline present in the crude oil and crack the balance of the oil into gasoline and coke. At the present time the cracking of heavy oil is producing approximately one-third of the total gasoline of the United States, or at the rate of over four billion gallons of gasoline for the year 1926. This volume of cracked gasoline is equivalent to having discovered vast oil fields producing 500,000,000 barrels of crude oil a year. Expressed in another way, each cracking unit is equivalent to a thousand barrel oil well yielding approximately 50 per cent gasoline of marked anti-knock properties.

In the United States at the present time, about 800,000 barrels of heavy oil are being cracked a day, with an average yield of approximately 35 per cent gasoline. The cracking equipment necessary to convert 800,000 barrels of cracking stock into gasoline costs in round figures $200,000,000.

The cracking process has conserved our crude oil supply and has also produced a motor fuel superior to that obtainable from the crude oil. Cracked gasoline has a relatively high anti-knock value compared with straight-run derived from the same crude oil. Cracked gasoline permits of the use of a higher compression motor than is now being built by the automotive industry, which means that greater mileage could be obtained from a gallon of such gasoline. The average cracked gasoline being produced in the United States would give approximately 25 per cent more mileage in a high compression engine than is possible with straight-run gasoline derived from the same crude oils. This factor alone of power potential in cracked gasoline is equivalent to having added approximately a billion gallons of gasoine to our supply for 1926. The increased power potential present in cracked gasoline over straight-run is equivalent to having added 100,000,000 barrels of crude oil to our supply during the year 1926.

*Read before American Society of Mechanical Engineers, Tulsa, Oklahoma.

Conversion of Heavy Oils

The cracking of oil is a chemical phenomenon taking place commercially under heat and pressure. The hydrocarbon oil undergoing change is dissociated into gasoline and coke under operating temperature and pressure conditions prevailing. The production of gasoline and coke takes place by pumping hydrocarbon oil through a continuous pipe coil and said oil is heated therein to a temperature of approximately 800 to 950 degrees F. under pressure of 200 pounds more or less, depending on the type and gravity of the oil treated. The heated oil from the continuous pipe coil passes into a reaction chamber which is insulated. The heated oil vaporizes therein, passing to the bottom of a fractionating column, coming into contact with the raw charging stock which is pumped from the storage tank into the fractionator. The gasoline portion of the vapors passes from the top of the fractionator to a water condenser under the pressure of the system and is continuously discharged from the receiver to storage. The heavier portions of the vapor in the fractionating device are liquefied by the incoming charging stock and combine with the unvaporized portion of the raw charging stock and pass to the suction side of a hot-oil pump, to be pumped through the heating coil and subjected therein to cracking conditions under controlled temperatures and pressures. The coke formed during the chemical reaction accumulates in the reaction chamber. As a function of the temperature conditions prevailing in the cracking system under the operating pressure, gasoline of high anti-knock qualities is produced. In this type of operation simultaneous topping, cracking and coking take place all in one operation.

Theories of Knock in Gasolines

Many theories have been propounded to account for the knocking of hydrocarbon oils in automotive engines. A number have been merely speculations. Much experimental work is going on to determine the precise phenomenon which takes place during combustion in an automotive engine.

The theory of the slapping of the pistons against the cylinder wall to account for the knocking of gasoline has had its day in court and is no longer tenable.

The radiation theory of detonation by Horning and based upon Perrin's work has had no experimental verification as yet. This theory holds that detonation results in a combustion mixture by the activation due to radiation, which precedes the flame propagation which is absorbed by the hydrocarbon gases decomposing to carbon, lighter hydrocarbon and hydrogen. The knock produced is considered to be due to the high velocity of combustion resulting from radiation bringing about a high pressure wave in the engine.

The electron theory of Wendt holds that the flame velocity is increased as a function of electron emanation in the burning gases. This theory does not square with the facts and has not been experimentally verified.

One theory holds that there is a formation of acetylene during combustion and that the knocking of certain motor fuels is a resultant thereof. It is well known that acetylene is a high detonating gas under combustion conditions, but acetylene has not been shown to be present in the gases of combustion of a motor.

It is also held that hydrogen is the knock component of combustion gases in an automotive cylinder due to the reaction between air and hydrocarbons. Experimental evidence shows that hydrogen is usually a component in the exhaust gases from an automotive engine. The gas hydrogen has been shown to be present in exhaust gases in percentage as high as seven.

Two Theories

Another theory endeavors to explain the phenomena of detonation by assuming that there is a molecular collision of un-acted upon gasoline from the frontal high pressure wave, by hydrogen, carbon monoxide, carbon dioxide, oxygen, nitrogen and methane.

An assumption of what takes place in an automotive engine during combustion of gasoline is termed the dissociation theory. This is based upon the dissociation of carbon dioxide and water under the temperature and pressure condition prevailing in the cylinder. This dissociation theory holds that there will be an increase in volume in gases in the cylinder due to this phenomenon, however, small credence can be placed upon this explanation that

knocking results from dissociation of gases which have already been formed during combustion in an engine.

There are only two theories which seem to square more nearly with the facts of detonation and they have been enunciated by Ricardo, Ridgly and Boyd.

Ricardo holds that detonation appears to be an explosion wave set up within a cylinder of the engine. The combustion of the gases starts slowly at the point of ignition and increases to that velocity and temperature with a high pressure frontal wave, so that the unconsumed gas of the wave is compressed with a temperature rise taking place within the unburned gases, bringing about a spontaneous ignition therein. When the rate of compression and temperature rise of the unburned gases in the cylinder reaches a point so that the heat is not dissipated by convection and also by conduction through the cylinder walls to the cooling water, there is an autoignition condition set up which brings about an explosion wave striking the walls of the cylinder with the hammerlike blows called knock or detonation. It appears as if detonation is largely dependent upon the velocity of burning of the original combustion gases in the cylinder which is first ignited.

What Takes Place

A simple statement of what apparently takes place in an automotive cylinder is as follows: When a mixture of air and gasoline is passed into an automotive cylinder and ignited by the spark plug, burning takes place. The burning gas travels in a wave front which compresses the unburned gas before it. When this compression of the unburned gas reaches a point of sufficiently high temperature, the unburned gas explodes, giving the detonation phenomenon unless the heat generated by the compression is dissipated through the cylinder walls. When knocking occurs, a temperature rise is noted in the cylinder and a hotter engine results which aggravates the detonation conditions. The knocking phenomenon therefore dissipates energy, due to the high temperatures, which is lost to the cooling water surrounding the cylinder; hence a loss of power is incurred.

Midgeley and Boyd explain the mechanism of knocking as being a resultant of the impacting of a high velocity, high pressure gas wave against the cylinder walls and head of the motor.

Ricardo, Midgeley and Boyd and others have shown that the tendency of a gasoline to detonate is a primary factor in judging its value for use in an automotive engine. It is almost certain that the magnitude of detonation is a function of the velocity of burning of a gasoline and detonation is less, the slower the gasoline burns in an automotive engine. It appears to be well established that a low velocity of combustion is highly advantageous, for no gasoline has been found so far, which could burn at too low a velocity in a high speed engine. It has been found experimentally and theoretically that all volatile gasolines have practically the same efficiency in an automotive engine when a non-detonation condition exists therein. Experimentation has indicated that the performance in an engine of a gasoline, is a function of the percentage composition of the paraffin, unsaturated, naphthene and aromatic hydrocarbons. The smaller the percentage of paraffin hydrocarbons present in the gasoline mixture of Navy specification, the better the motor fuel as to anti-knock properties.

Groups of Hydrocarbons

In all gasolines there are four groups of hydrocarbons present, called paraffin, unsaturated, napthene and the aromatic series. Depending upon the percentage composition of these various groups, a gasoline may be a high-knocking or non-knocking fuel in an automotive engine.

One of the most interesting problems in the oil industry today is the increase of the anti-knock properties of gasoline. For many years, it has been held that straight-run gasoline from paraffin base or semi-asphaltic base oils was a superior product. This has been greatly modified since the commercial cracking of heavy oils into gasoline. For the cracking of heavy oils under heat and pressure is so flexible that the percentages of unsaturated, naphthene and aromatic hydrocarbons can be increased at will, and it is these groups of hydrocarbons which give the anti-knock properties to cracked gasoline.

The knocking propensity of a motor fuel is without question its most important characteristic, and the knocking properties of gasoline are primarily a function of its chemical composition. The work of Ricardo, Midgley Boyd and others show that the values of the anti-knock qualities of hydrocarbons are in the following order: (1) The paraffin hydrocarbons of Navy specification boiling points are the worst knockers in an automotive engine. (2) The unsaturated hydrocarbons are materially less knocking in an automotive engine than the paraffins. (3) The napthene hydrocarbons are distinctly better as anti-knock material than the unsaturated or paraffin hydrocarbons. (4) The aromatic hydrocarbons are non-knocking under any practical compression pressure commercially producible in an automotive engine.

Paraffin Hydrocarbons

The paraffin hydrocarbons are straight-chain compounds composed of hydrogen and carbon. The percentage of hydrogen in relation to the carbon content of the molecule is at its maximum in this straight-chain type of hydrocarbon.

The paraffin hydrocarbons have a chemical constitution of such character that when combining chemically with air under pressure, they have a tendency to explode at high velocity instead of burning slowly. The paraffin hydrocarbon series also have a terminology called saturated hydrocarbons which means that the carbon atoms in the molecule are combined with the maximum number of hydrocarbon atoms possible according to our theory of valence.

Unsaturated Hydrocarbons

The unsaturated hydrocarbons are straight-chain compounds similar to those of the paraffins but have a chemical constitution differing very materially from the paraffins. The combustion of the unsaturated hydrocarbon in an automotive engine apparently takes place slowly while under pressure, so that there is no knocking tendency when this type of gasoline is used. This is a function of the chemical constitution of the molecule; the only difference between the unsaturated hydrocarbons and the paraffins is that the unsaturated compounds have two hydrogen atoms less to the molecule than the paraffins. This apparently slight difference in the chemical composition between the two groups of hydrocarbons profoundly modifies the chemical combination with air under the conditions prevailing in an automotive engine.

Straight-run gasoline from crude oil does not contain unsaturated hydrocarbons of the straight-chain series to any material extent. They are produced in relatively large amounts by means of heat and pressure under cracking conditions. The unsaturated hydrocarbons therefore have greater utility in gasoline than those derived from crude oils of paraffin and semi-asphaltic base.

Naphthenes

The naphthene hydrocarbons present in gasoline to some extent are those derived from the California, Texas, Smackover and other crude oil fields and they have anti-knock properties which give greater utility in automotive engines than those of the paraffin or unsaturated series hydrocarbons.

The napthene hydrocarbons are of cyclic or so-called ring structure in contradistinction to the straight-chain hydrocarbons of the paraffin and unsaturated series. The naphthenes have the maximum percentage of hydrogen possible under its cyclic or ring structure, and they act chemically under normal conditions somewhat similar to the paraffin hydrocarbons, yet under the compression pressure of an automotive cylinder they burn slowly and quietly without explosive violence under relatively high pressure. It is the chemical structure of the naphthene

molecule which makes it superior to the straight-chain hydrocarbon of the paraffin and unsaturated series. The naphthene hydrocarbons are produced under cracking conditions in material percentages over that prevailing in the normal gasoline derived from the same crude oil.

Aromatic Hydrocarbons

The aromatic hydrocarbons are of cyclic structure similar to the naphthenes but have six less hydrogen atoms to the molecule than naphthenes. This modification of the hydrogen content of the aromatic hydrocarbons over the other groups yields a slow-burning, non-detonating gasoline for any practical compression pressure of a motor.

The aromatic hydrocarbons are present in straight-run gasolines derived from California, Texas, Smackover, Java, Borneo and other oil fields. In the Mid-Continent, Pennsylvania and similar oils, the aromatic content is practically negligible. The aromatic hydrocarbons are produced from heavy oils by means of chemical conversion under heat and pressure to a much higher per cent than those present in straight-run gasoline.

The cracking of heavy oils into gasoline increases the yield of unsaturated, naphthene and aromatic hydrocarbons materially above those present in straight-run gasoline. It is the chemical production of these natural anti-knock hydrocarbons which gives cracked gasoline its non-knocking properties under service conditions prevailing in an automotive engine.

Representative samples of straight run and cracked gasolines derived from Cushing crude oil, Somerset, Kentucky, were analyzed by chemical means for their percentage composition of paraffin, unsaturated, naphthene and aromatic hydrocarbons. The values obtained from these various groups of hydrocarbons were converted into the highest useful compression value in an automotive engine. The same gasolines were subjected to automotive tests in a Hupmobile, four cylinder engine, and their knock value determined by the listening method and spark advance. The spark advance values were also determined for known mixtures of benzol added to straight-run gasoline, and the unknown motor fuels were compared with the known. This method showed an excellent check as to the value of the different gasolines as determined by chemical methods. The following tables indicate a wide variation in the percentage composition of the various groups of hydrocarbons in the different gasolines. However, the cracked gasolines will operate satisfactorily a high compression motor of the highest useful compression ratio of from 5.2 to 5.9.

Table 1 gives a comparison of the hydrocarbons in straight-run and cracked gasolines, with their aromatic equivalent and highest useful compression ratio.

Table 1.—Comparison of Hydrocarbons in Straight-Run Gasoline and Cracked Motor Fuels

(Figures in per cent.)

Hydrocarbons—	Cushing, Okla.		Somerset, Ky.	
	Straight-Run	Cracked	Straight-Run	Cracked
Unsaturated	1.6	10.9	3.8	12.5
Aromatic	4.9	19.8	5.3	14.9
Napthene	23.7	18.0	20.6	11.8
Paraffin	69.8	51.3	70.3	60.8
Aromatic Equiv.	11.1	26.5	11.1	20.4
Highest useful compression ratio	5.1	5.6	5.2	5.5

Table 2.—Analysis of Various Cracked Gasolines

(Figures in per cent.)

Hydrocarbons—	Tonkawa Braman N. Kans. Topped Crude	Ky. Fuel Oil	Smackover Heavy Crude	N. Tex. Fuel Oil	Lost Soldier Wyo. Crude
Unsaturated	16.1	14.4	14.7	16.0	11.7
Aromatic	17.8	22.5	27.5	18.6	15.0
Naphthene	12.8	10.0	21.2	11.7	15.4
Paraffin	53.3	53.1	36.6	53.7	57.9
Aromatic Equiv.	24.2	27.9	36.7	24.7	21.2
Highest useful compression ratio	5.6	5.7	5.9	5.6	5.5

Table 2 shows the analyses of various cracked gasolines derived from the heat and pressure treatment of a mixture of Tonkawa, Braman and North Kansas topped crude, Kentucky fuel oil, Smackover heavy crude, North Texas fuel oil and Lost Soldier, Wyoming topped crude.

Gasoline Sold at Retail Unchanged in Quality

The quality of motor gasoline sold in the United States in the past few years has undergone very little change, the Bureau of Mines, Department of Commerce, finds as the result of special surveys made in the larger cities semi-annually. The net results of these surveys indicate that the gasoline now being sold is approximately equal to that sold six years ago, and in the intervening time. Examination of samples taken directly from the service-station pumps in widely scattered cities of the United States, by Bureau of Mines employees, and placed in screw-cap cans with light, leak-proof tops, shows that there has been very little variation in the average values for the gasolines thus gathered. In each of these semi-annual surveys, about 150 representative samples were collected for examination.

There is no necessary relation between the gravity of a gasoline, and its volatility or utilization as a motor fuel, the Bureau points out.

Whether gasoline in the future will have approximately the same characteristics that it has had since 1920 will depend to a great extent on whether it will be necessary or desirable that it have those characteristics, according to A. J. Kraemer, associate petroleum chemist, Bureau of Mines. This question is bound up in the topic of automotive developments.

There is a distinct advantage in using a motor fuel as heavy as can be utilized by the engine, in that the energy content of a heavy fuel is in general larger in terms of B. T. U. per gallon than a lighter fuel. Motor fuels are almost exclusively sold in this country on a volume basis. Another factor is that the demand for gasoline is enormous, and everything which can be made to serve as motor fuel will, sooner or later, have to be so used. When crude oil and gasoline are as plentiful as they have been during the past few years, there is not the incentive to the most economical utilization, which should be the case. This is not to say that considerable progress has not been made in increasing the yield of gasoline and other valuable products from crude oil. Refining equipment used by progressive refiners is constantly being improved, and is measurably superior to what it was even five years ago.

More Jenkins Cracking Units

East Chicago, Ind.—Graver Corporation, East Chicago, Indiana, who have the sales and manufacturing rights for the Jenkins Cracking Process announce the sale of three additional units.

White Eagle Oil & Refining Company of Kansas City will install a 1000 barrel unit at their Casper, Wyoming, refinery.

Peerless Oil & Refining Company of Chanute, Kansas, will install their second 1000 barrel unit.

Kanotex Refining Company at Arkansas City, Kansas, have a second unit under construction at the present time.

Simms Building Plant

Smackover, Arkansas.—The Simms Petroleum Company has completed installation of a portable gasoline plant of the charcoal type near Snow Hill. This plant is operating on flush gas of the area, while the installation of a permanent charcoal plant is being completed. The two plants are being installed by the Gasoline Recovery Corporation.

Four-Tube Condenser Box Saves Time*

By H. L. Kauffman

TIME saved in doing routine laboratory work in a petroleum refinery laboratory—as in any other laboratory, industry or business—means a saving in money. Hence, if laboratory equipment can be so changed or improved upon that one person either can do twice as much work, or can do the same amount of work in one-half the time—then the financial benefits to be derived from such improvements are self-evident.

With the single-tube condenser box most frequently used in the majority of laboratories in making Engler distillation tests, it is almost impossible for one man to run more than two tests simultaneously—that is, if all the temperature and per cent readings are being taken. It is true that three or four—sometimes even five—distillation tests can be run at once, if, let us say, only an initial boiling point and an end point are desired. However, even then, skill on the part of the operator is needed in so timing the start of the distillation and the rate of distilling that only one distillation will be completed at a time; and when, as it frequently happens, two end points are being reached at the same time on equipment not adjacent to each other—then the tester encounters difficulty, often misses the end point and hence in many cases is compelled to repeat the test.

To overcome the difficulties and the time expended in running distillation tests making use of single-tube condenser boxes, many companies are making use of especially-built boxes containing three, four and even five condenser tubes. The Texas Company was one of the first companies to follow this practice and as long as ten years ago—perhaps even longer—used four and five-tube condenser boxes when making Engler distillation tests.

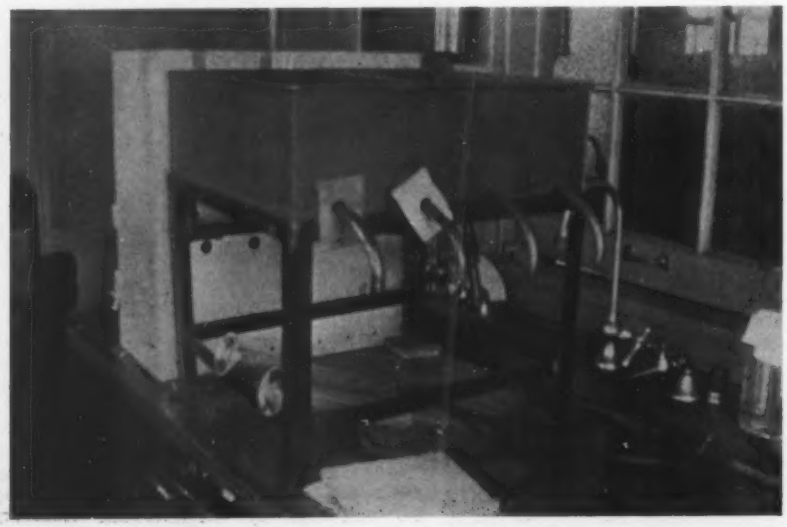
*Consulting Petroleum Chemist.

The illustrations accompanying this article represent sketches and views of the shield and condenser box made by The C. J. Tagliabue Manufacturing Company on specifications furnished by the buyer.

Better Heat

Although this equipment has been used successfully for nearly a year, the writer is inclined to believe that a further improvement that would facilitate the ease of the work could be accomplished by using electric heating units in place of the gas burners indicated in the sketches as now being used. However, for the company or individual who is giving consideration to the construction of a shield and a condenser box of this type, and if gas is to constitute the source of heat, it is further suggested that at least the lower portion of the shield, housing the burners, (or perhaps, better yet, both the upper and lower portions) be divided by partitions into four compartments instead of merely the two into which the equipment being described is now divided. A separate compartment for each burner gives further assurance to the tester that radiated heat is not affecting the results of the distillation test.

For the laboratory that has available a small, closed room—free from all draughts—the writer would recommend the use of the multiple condenser box alone, with suitable supports for holding the flasks, but without the use of a shield surrounding the burners and flasks. Such an arrangement is more convenient than any other, but has the objection that the tester frequently is compelled to work in a sultry, exceedingly warm room. Against this, on the other hand, are the inconveniences frequently encountered in setting and arranging flasks and burners in the type of shield under discussion in this article.



Four Tube Condenser Box

The box is made of No. 16 gage copper plate and is 16 inches wide, with an inside length of 15 inches. A partition, having a ½-inch opening in it near the top to allow water to overflow from one part to the other, divides the box equally. This arrangement makes it possible to "ice up" only half of the box, when it so happens that only one or two distillation tests are to be made.

Then condenser tube is 9/16-inch O. D. No. 20 Stubbs gage seamless brass tubing and is 22 inches long. The lower end of the condenser tube is cut off at an acute angle, and is curved downward for a length of 3 inches—and slightly backward, so as to insure contact with the wall of the graduate at a point 1 to 1¼ inches below the top of the graduate when it is in position to receive the distillate. The condenser tubes are placed 4 inches from each other—the first and fourth tubes being two inches from the sides of the condenser box. Each compartment of the box is provided with a ½-inch opening for draining, and, in addition, the farther compartment is fitted near the top with a ½-inch overflow pipe.

The box is 6 inches deep, and rests upon a supporting frame 12 inches from the table; also, that the distillate end of the condenser tube is 9½ inches from the top of the table.

A shield is used in connection with the above-mentioned, four-tube condenser box. This shield is 8 inches by 17 inches in size, and, in this case, is divided into only two compartments. However, as previously mentioned, the writer believes that a division into four compartments would be better. This view shows the manner in which the openings, upon which the Engler flasks rest, are located.

This shield is 19 inches in height; also, that the top part of the shield—the part nearest the condenser box—is slotted so that the tubes and Engler flasks can be readily joined together. These slots are ¾ inch in width and extend downward for a distance of 2½ inches. Attention, also, is called to the arrangement of the two doors to the shield; the piping arrangement for the gas burners; and the four "peep holes"—two in each door—for noting the appearance of the flame.

The entire shield is made of No. 10 gage galvanized iron. All the seams are riveted and all inside surfaces are covered with sheet asbestos.

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The valve line of the Homestead Valve Manufacturing Company, Homestead, Penna., is presented in a new catalogue, now ready for distribution.

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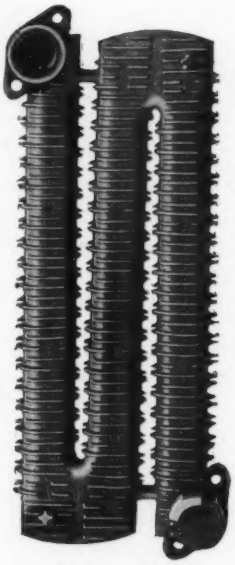
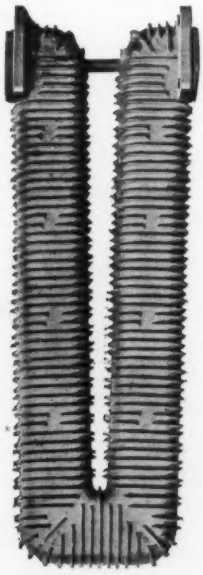


14 Square Foot Section



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The Hermy Tar Distillation Process

By Ismar Ginsberg

THERE are two principal processes which are employed in the distillation of tar. First there are those processes which are continuous in operation and second there are those which are discontinuous. The discontinuous processes merely subject a given mass of the substance to distillation. On the other hand the continuous processes are all more or less protected by patents. However, it remains a fact that in spite of the relatively large number of these methods there are but few, if any, that are really commercially applicable. For the most part the degree of practicality of these processes is but small. It must be remembered that the distillation of tar involves not only the production of a suitable oil product, but also the recovery of a residuals mass which should be as constant as possible in properties. This complicates the distillation process and is perhaps the chief reason why it has been so difficult to perfect a continuous distillation process which is commercially feasible.

The important point in the practical manipulation of the distillation process is not whether the process is continuous or discontinuous, but rather if it can fulfill a number of fundamental requirements. Thus for example, the process must be of such character that it can be installed at minimum cost and with a high productivity. It must be easily and inexpensively maintained, and it must not require too much attention. The product that it manufactures must be satisfactory in all respects, and must be obtained with a minimum consumption of steam. It must be safe to operate and finally the various parts of the installation must be all in sight and the space requirements must be such that the apparatus does not occupy too much space in the plant.

The important consideration in the continuous process is the maintenance of the temperature at a constant point, so that the properties of the residual substance remain unchanged, and the characteristics of the oil product do not vary. This is absolutely necessary, and requires the use of automatic temperature control apparatus, for the hand manipulation of the steam valve does not afford an efficient method for controlling the temperature conditions of the process. Furthermore, this is not the only factor that requires watching. The speed at which the oil is allowed to flow through the still is also important and must be accurately controlled. It is a fact that the difficulty that has been found in regulating these two factors and secure a product of the proper and constant qualities has been responsible for the rather limited success that the continuous process has had in actual practice.

Duration of Process

The time required to distill a mass of tar depends mostly on the time that it takes to remove the water content of the tar. For the dehydration stage of the distillation is the one that takes longest. There are a number of different methods which are used for removing the water from tar. Thus, for example, there is the so-called mechanical process of centrifuging, which consists in causing the water particles to leave the tar particles under the effect of centrifugal force. The crude tar can also be heated and then allowed to stand whereas in cooling a considerable part of the free water separates out from the tar. Then there is steaming of the tar by heating the same in the still, which results in a complete removal of its water content.

It follows that an important detail of the tar distillation process is the dehydration process which is easy to carry out and which gives good results in a minimum of time. It has not been found best practice to combine the two processes in the same apparatus, for when the operations are carried out in this manner, it will be found that a very large installation is required, because of the long time that the tar remains in the distillation plant. The costs of the operation are necessarily increased due to the increased interest charges on the investment and the amortization. It is an undeniable fact that if the distillation process is to be a commercial success it is essential that the dehydration of the tar be carried out as a separate operation, independent of the actual distillation.

As far as the dehydration of tar is concerned, the same general classification of the methods employed in the plant may be made as in the case of the distillation process proper. In other words the tar dehydration processes are either continuous or discontinuous. Then again the processes may be classed as direct fired or indirect fired, in the latter case steam being used. It is also possible to employ hot water as the heating medium, and in this case it of course follows that the tar will not be further distilled, for the temperature cannot be brought up to the distillation point with the use of hot water.

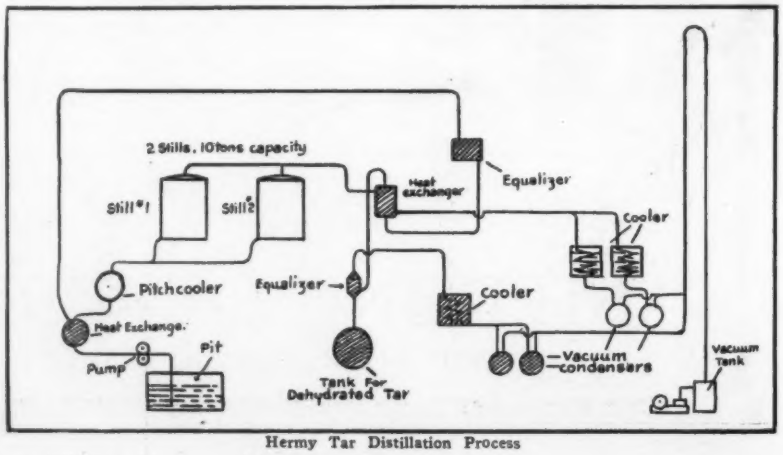
The heating medium should be so selected that the cost of heating is at a minimum and this can be done by utilizing the waste heat that is available in any oil refinery. While there may be effected some saving in the labor of attendants and maintenance as well as repair, as applied to the tar distillation and dehydration installation, nevertheless a careful analysis has shown that the place where the greatest saving can be made is in the consumption of heat. A great deal of heat will always go to waste in the form of flue gases, and under the proper conditions it is a comparatively easy matter to recover some of this waste heat as well as other waste heat from other sources and put it to work in the dehydration plant if not in the distillation plant.

It must also be mentioned that there is a large amount of heat in the pitchy residues that remain behind in the still after the process has been completed. Most of the processes which are employed in practical operation at present do not make use of this waste heat in the proper manner or not at all. It follows that a dehydration process that will be economically advantageous will be one in which the operation is continuous and in which waste heat is employed as the heating agent.

Using Waste Heat

A new process has been developed in which the waste heat that is liberated during the process of distillation is utilized with the result that the thermal efficiency and economy are very marked. Another advantage of this process, which is known as the Hermy semi-continuous process is that the tar is dehydrated with the aid of heat in a continuous operation.

In this process which is described in detail in an article published in Erdoel und Teer, 1925, volume XXXIII, the further distillation of the dehydrated tar is car-



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R. C. HOLMES, *President*

17 Battery Place, New York, N. Y.

ried out in the usual manner in stills with the aid of a vacuum, and well fractionated products are obtained. Furthermore, the residue that remains behind in the still is all that could be wished for as far as its properties and constancy of composition are concerned.

A particular feature of the Hermy process is the use of vacuum in the continuous dehydration of the tar, in which the steaming of the product is accomplished at low temperatures in the quickest possible manner. The process is one that posses the highest importance for the tar distillation industry.

As has been mentioned, the complete dehydration of the crude tar is accomplished with the utilization of the waste heat that is recovered not only from the pitchy residues but also from the condensation of the tarry vapors. The crude tar is pumped from the crude tar storage tank through a heat exchanger in a stream which is regular and well under control at all times. At the same time a stream of hot pitchy still residuals is being pumped through the heat interchanger in the countercurrent direction. In this way an interchange of heat takes place, and the crude tar is heated up to the same extent that the pitchy residuals are cooled. It is possible to maintain any desirable temperature in the outflowing crude tar by regulating the flow of the tar through the apparatus as well as that of the pitchy residues. Both the latter is quickly and advantageously cooled, and the crude tar is considerably heated up. The cooled residuals can then be worked up directly, while the tar is allowed to flow in an uninterrupted stream into the dehydrating apparatus.

However before it enters the dehydrators it flows into an equalizing tank which is in the nature of a second heat interchanger. The use of the latter apparatus is necessary in order to make use of the heat that is liberated in the condensation of the tarry vapors. After the crude tar has attained the proper temperature on passing through the second heat interchanger, it is sent to a slime separating apparatus, which is located directly over a receiving tank. The entire system is maintained under a vacuum, so that when the tar enters the slime separating apparatus, due to the low pressure that exists in that apparatus considerable evaporation of the water content of the tar ensues. The degree to which the dehydration of the tar takes place in this manner is controllable by means of the temperature of the tar entering the ap-

What About the Weather?

It was Mark Twain, who spoke to the effect that many talk about the weather but few do anything about it.

Nowhere is that better applied than in the business of selling gasoline. When no other reason can be given for a drop in gasoline prices, the weather gets the blame. Weather seems to be the excuse, when no other reason can be found.

It is assumed that a change in weather conditions means a change in gasoline consumption, which means lower prices.

Undoubtedly weather conditions do affect gasoline sales. Records kept at filling stations prove that.

But a day of rain over an area of the Middle West cannot be set down as a reason for a weak market in refined circles. To charge one day of rain with beating down prices at refineries in Oklahoma may be just talk about the weather.

Conclusions like that are not far removed from those by which grain prices were hammered down in Chicago, just because rain began to fall outside. The season was such that rain over the wheat country meant a great wheat crop. So traders on the floor began selling.

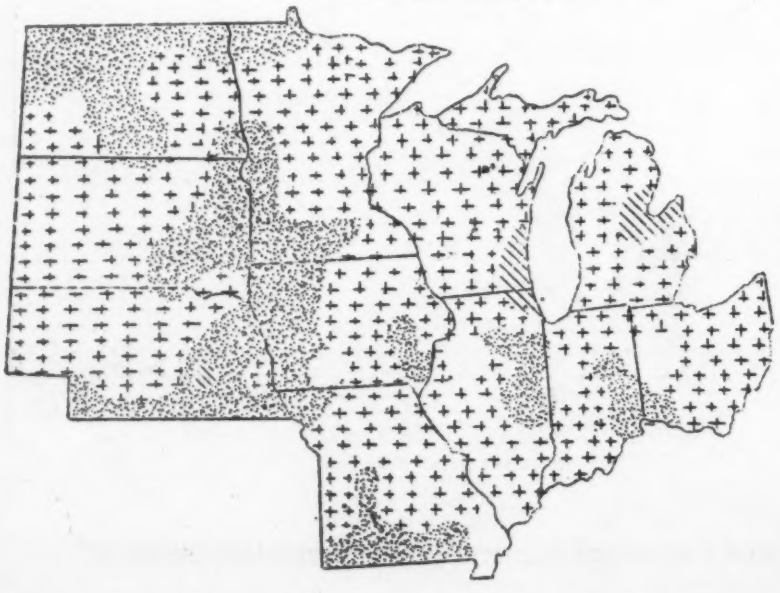
It was just a local shower and the wheat country as a whole never felt it. Wheat remained in need of rain while a city had it.

All of which gets around to the fact that the Western Petroleum Refiners Association has set out to determine just what effect weather condition do have on gasoline prices and consumption. It may be better to state it that this organization has set about to furnish information by which refiners can deermine what effect rain and temperature have on the gasoline market.

This is to be possible through weekly bulletins on weather conditions over the area where the bulk of gasoline made in the Mid-Continent is sold. The bulletins are compiled as the following excerpt from the first one reads:

"The information is based principally upon reports of the U. S. Weather bureau for the 47 representative cities listed in the tables, however, reports from 134 additional weather stations scattered through the eleven states were also consulted in the preparation of the map in order that the conditions shown for large areas should be typical and not simply reflect those prevailing at the designated cities. As absolute normal seldom occurs a tolerance of 10 per cent is allowed in arriving at both approximately normal temperatures and precipitation. For example, if the normal temperature at any point for a certain day is 50 degrees, all temperatures from 45 to 55 degrees are considered as approximately normal. Temperatures used throughout the tables and as a basis for the map are the mean between the high and low records for the day, this being the basis used in government figures for prevailing temperatures."

For the Week Ending Friday, May 14, 1926



LEGEND

Temperature	Precipitation
Above Normal	More than Normal
Above Normal	Less than Normal
Above Normal	About Normal
Below Normal	More than Normal
Below Normal	Less than Normal
Below Normal	About Normal
About Normal	More than Normal
About Normal	Less than Normal
About Normal	About Normal

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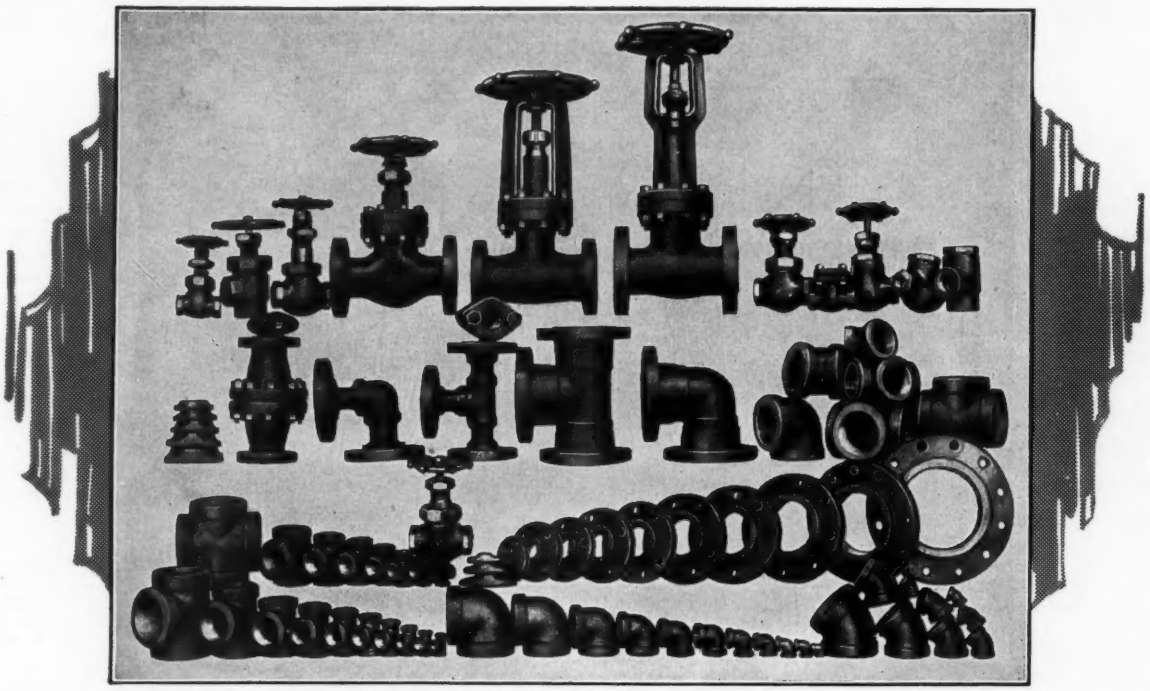

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paratus and the degree of the vacuum that is maintained in the apparatus. The vapors are condensed and yield the first runnings while the steamed tar is allowed to flow into the receiving tank which is located under the slime separating apparatus. From this point the tar is sent to the stills for further distillation.

The dehydration of the tar in the Hermy continuous process takes place during the time that the tar, which has previously been dehydrated, is being distilled down to the form of pitch in one of the stills, and the vapors of the tar distillates from this still are made to pass through the second heat interchanger and yield up their heat, on condensation, to the crude tar that is flowing through this apparatus in countercurrent. The hot pitchy mass in the still is also removed from it and made to pass through the first heat exchanger and there to yield up its heat to the tar that is flowing through that apparatus also in countercurrent. In this manner the entire process is continuous and the amount of tarry products that can be put through the installation is very great considering its size. The whole operation can be perfected and proportioned in such a manner that while the hot tar is being distilled down to the state of a pitch, a sufficient quantity of crude tar is being heated up to the proper point and made ready to enter at the time that the distillation of the first charge has been completed and the pitchy residues have been removed.

Two Stills Required

The installation generally consists of two stills, which may be seen in figure 1, which are used alternately for the distillation of the tarry mass.

A double blast system is employed for making use of the high temperature heating gases. It must be remembered that rapid and complete transmission of heat from the heating gases and the hot tarry masses in the stills will take only when the temperature difference between the two is marked. This condition however does not really exist in the case of the Hermy distillation process. This is due to the use of two stills, for while one still, which is being fired and driven to the point of pitch residues, by switching the travel of the hot gases, the second still, which is previously filled with the dehydrated tar, catches the gases that escape from the first. The temperature of the dehydrated tar is comparatively low when compared with that of the heating gases and hence a rapid exchange of heat takes place.

The fact that the Hermy distillation process has considerably more capacity than the regular process can be seen from the following comparison. In the Hermy process, for the production or throughput of forty tons of tar per day, twenty-four hours, two stills are required, each of ten tons capacity, together with the requisite auxiliary apparatus. The arrangement of the apparatus is seen in the accompanying illustration. But when the same throughput is required of an ordinary distillation plant, it will be found that from four to five of the ten tons stills will be necessary to handle efficiently the forty tons per twenty-four hours.

The thermal efficiency of the process is naturally very high. Thus for the distillation of forty tons of the tar the total coal required will be only 2000 kilograms compared with 5270 kilograms in the ordinary process. The apparatus is also cheaper and occupies less space.

New Theory On Detonation Offered

Experiments at University of Ohio outlined by American Chemical Society

COMPOUNDS of lead, among the cheapest of metals, are the greatest foe of knock in automobile engines, while chlorides of gold and platinum are powerless to suppress it, a report of researches covering the whole field of anti-knock materials made public by the American Chemical Society declares. A theory of detonation new to science is described.

The experiments, carried on in the chemical laboratory of Ohio State University at Columbus by William Hale Charch, Edward Mack, Jr., and Cecil E. Boord, covered the whole field of anti-knock materials.

The researchers determined and classified all anti-knock compounds as well as compounds without effect in attacking knock in automobile engines, to eliminate which is a major effort of science.

Lead Best

Lead tetreaethyl was found to be the most formidable of the anti-knock compounds, the report said, and all comparison was based upon a value of 100 attached to this compound as "the anti-knock co-efficient."

Lead diphenyl dimethyl ranks second with a value of 97 and lead diphenyl diethyl third with 93.5. Lead diphenyl diiodide scored 80, lead diphenyl dichloride scored 72, and lead diphenyl dibromide 60. Lowest in the scale of anti-knock compounds, the investigators discovered, was aluminum ethyl iodide, called "very weak, owing to iodine content." Twenty-five compounds were classified in the report as anti-knock.

Thirty-four compounds proved to be worthless in suppressing knock. These included gold chloride, platinic chloride and nitrogen sulfide.

"None of these compounds," said the report, "exerted the slightest effect in suppressing the intensity of the explosion. Diethyl selenide even appeared to increase the loudness of the reports.

"Less than 0.1 per cent of chromium pentaphenyl bromide would be dissolved in a fuel suitable for the test. This compound would be expected to exhibit anti-knock properties if larger concentrations could be tested."

New Knock Theory

The investigators offer a new theory of detonation, which attempts to explain the way in which tetraethyl lead, studies of which by Thomas Midgley, Jr., and Thomas A. Boyd, resulted in the production of ethyl gasoline, prevents anti-knock.

This theory, it was was pointed out, is a striking development of science because it proves it will bring progress in the conquest of knock affecting the nation's 20,000,000 motor vehicles. Chemical science previously had shown that tetraethyl lead would suppress knock. The Ohio state researchers think they have solved the mystery of why it suppresses knock.

According to their theory, in the explosion which takes place in the gas engine tetraethyl lead decomposes suddenly into infinitesimal particles of metallic lead, which act as centers for partial burning.

These little particles themselves burn as the flame front approaches them and thus they make the flame travel faster than if they were not present. This condition is described as somewhat like that of millions of unimaginably small spark plugs that ignite the gas just ahead of the flame front.

"Thus, by virtue of the multiple centers of high temperature created by the burning of these little particles of lead," says the report, "there is initiated evenly ahead of the main flame front a partial oxidation or an auxiliary burn tending to maintain a combustion in a region of fuel which otherwise would be subject to detonation.

"The decomposition temperature of anti-knock materials, taken in conjunction with the temperature of the cylinder gases, thus determines at what stage in the cycle they shall begin to function.

"If the decomposition temperature is low, partial oxidation will begin earlier in the cycle and extend throughout a larger volume of yet unburned fuel than if it is high. In the extreme of the latter case, it would cause a lowering in the efficiency of the compound, while in the former it might cause slight preignition.

"The ideal anti-knock compound should possess a decomposition tem-

(Continued on page 85.)

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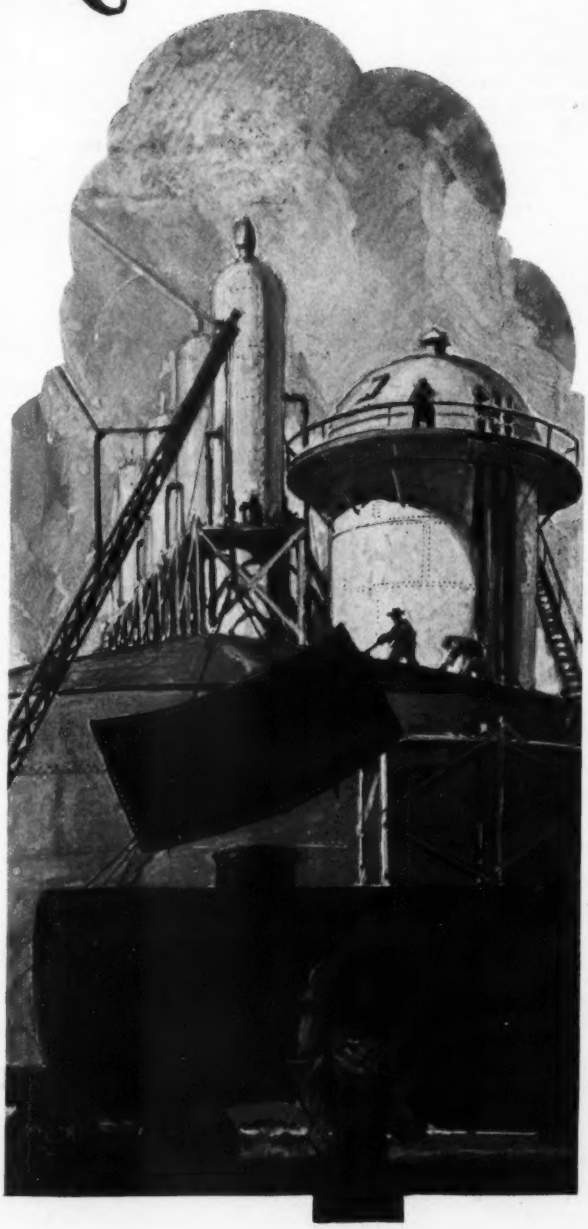

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Absorbent Oil For Natural Gasoline Manufacture*

By Arthur L. Davis
Chief Chemist Empire Refineries, Inc., Tulsa, Oklahoma

YEARS of experience, with constantly improved methods of manufacture with an improvement in the quality of products, have convinced the natural gasoline manufacturer that certain physical and chemical characteristics of the absorbent oil should be observed in order that the most satisfactory recoveries from natural gas might be obtained for the quality of the finished natural gasoline required.

Certain characteristics, which are given may be of questionable value in the opinion of certain experienced natural gasoline manufacturers, but are presented in order that all the properties of possible value might be given.

Color.—Good, to guarantee no lowering of color of the finished natural gasoline due to contamination by small quantities of lower boiling fractions.

Distillation.—Initial boiling point well above maximum boiling point of natural gasoline.

Doctor.—Sweet, to guarantee no contamination of finished natural gasoline by the presence of small quantities of sour absorbent oil.

Emulsion.—Good, in order that emulsion troubles in absorption system cannot possibly originate with the oil.

Pour Point.—Low, so that satisfactory circulation and distribution of absorbing medium may be had under all operating temperatures encountered.

Saturation.—High, since maximum saturation obtainable from gas of any given natural gasoline content, with equal recovery, lowers operation costs.

Unsaturation.—Low, since product of high per cent unsaturated compounds do not seem to be the most suitable absorbents.

Vapor Pressure.—Low, in order that losses due to saturation of all natural gas treated with absorbent oil may be reduced to the minimum.

Viscosity.—Low, in order that maximum distribution may be secured.

The work presented deals primarily with the saturation obtainable by the use of refined fractions of specially prepared oils for this purpose, but still those which may be easily available for plant use.

The vapor pressures of pure paraffin hydrocarbons, methane to hexane, (as gases) in equilibrium with the pure hydrocarbons, methane to hexadecane (as absorbents) were calculated. A natural gas taken to contain pure hydrocarbons, methane to octane, present in quantities directly proportional in per cent by weight to the vapor pressure of the respective hydrocarbons, indicated that butane was the most desirable absorbent. Experimental data indicates that octane (b.p. 259° F.) would be the best absorbent. Present conditions would limit the change from the average absorbent oil of average boiling point of 550° F.-570° F. to one of average boiling point of 250° F. to an absorbent oil of average boiling point of 450° F. (initial 400° F., maximum 500° F.

Absorbent Oil—Pure Hydrocarbons

The most satisfactory means of beginning such a study is to consider the action of certain pure hydrocarbons when absorbed in other pure hydrocarbons. In this manner we may obtain a preliminary view of what might be expected when we have a homologous series of these hydrocarbons, both in the natural gasoline and the absorbent oil, which will be finally considered. Other hydrocarbons, which are invariably present in varying proportions, have not been considered, since their inclusion would complicate calculations in a proportion not warranted by the amounts present.

According to Raoult's law the vapor pressure of a solution is proportional to the mol fraction of the solvent present in the solution. The vapor pressures calculated are those of methane, ethane, propane, butane, pentane and hexane in the homologous paraffin hydrocarbons, ethane, propane, butane, octane, decane, tri-decane and hexa-deane, at a temperature of 67° F. and a concentration of solute in solvent of 10% by volume. The values for the vapor pressures of methane, ethane, propane and butane were calculated by the use of critical data for these hydrocarbons in connection with Duhring's rule. The physical characteristics of the hydrocarbons used in this paper are shown in Table 1.

The vapor pressure of the binary car-

*Paper presented before the meeting of the Association of Natural Gasoline Manufacturers, Tulsa, Oklahoma, May 5th and 6th, 1926.

Members of the Association of Natural Gasoline

bon blends are shown in Table 2, with the data for methane, ethane, propane, shown graphically in Figure 1 and the data for butane, pentane and hexane shown graphically in Figure 2.

Considering the hydrocarbons, methane to hexane, as solute, with the other hydrocarbons as solvents, the individual hydrocarbons considered as the best absorbents for the solute used would be as follows:

Solute	Solvent
methane	butane
ethane	hexane
propane	hexane
butane	octane
pentane	decane
hexane	decane

Table 1. Physical Properties of Paraffin Hydrocarbons

	Formula	Critical Data: Boiling Point F.	Press. lbs. per sq. in.	Temp. °F.	Mol. Wt.	Specific Gravity 60° F. (H_2O=1)	Vapor Press. 60° F. m.m.
Methane	CH_4	—265	735	—114	16	0.441	61700
Ethane	C_2H_6	—135	664	— 95	30	0.446	22000
Propane	C_3H_8	— 49	647	207	44	.536	5375
Butane	C_4H_{10}	— 34	523	308	58	.600	1240
Pentane	C_5H_{12}	97	...	...	72	.626	370
Hexane	C_6H_{14}	156	...	...	86	.663	118
Octane	C_8H_{18}	259	...	...	114	717	15
Decane	$C_{10}H_{22}$	343	...	...	142	.750	2
Tridecane	$C_{13}H_{28}$	453	...	...	184	.792	1*
Hexadecane	$C_{16}H_{34}$	549	...	...	226	.815	1*

*Less than one.

Table 2.—Vapor Pressures of Pure Hydrocarbon Mixtures

Solvent—	Solute: Methane	Ethane	Propane	Butane	Pentane	Hexane
Methane	61700 mm.	....	....	....	...	...
Ethane	28390	22000	....	....	...	...
Propane	16010	7390	5375	....	...	...
Butane	14282	4085	1724	1240	...	...
Hexane	16676	3987	869	262	147	118
Octane	19210	4592	964	203	62	27
Decane	21552	5250	1099	223	59	17
Tridecane	24500	6115	1290	260	68	19.6
Hexadecane	27200	6940	1467	299	78	22.6

Table 3.—Properties of Natural Gases

	Gallons natural gasoline per 100 cu. ft. gas: 0.5	2.5	5.0
Gravity, specific (air=1)	0.681	0.785	0.905
@60°F. (H_2O=1)	0.438	0.4718	0.5025
Molecular weight, ave.	19.75	22.6	22.8
Nat. gasoline content by volume @ 60°F. %	1.435	7.275	14.35
Nat. gasoline gravity° A. P. I.	93.9	93.9	93.9
Vapor pressure, ave. m.m.	52110	50033	46321
Weight/gal. @ 60°F. lbs.	3.65	3.93	4.185
Weight/M cu. ft. lbs.	52.112	59.66	69.12

It may be noted, particularly, that decane, tri-decane and hexa-decane were selected, since their boiling points fall approximately at 350°F., 450°F., and 550°F., respectively. The average boiling point of 550°F., is probably characteristic of the most absorbent oils in use today.

The results obtained by calculating equilibrium conditions of pure hydrocarbons in other pure hydrocarbons at a definite percentage would indicate that the most optimum absorbents for these individuals were those of lower molecular weight and lower boiling point than were currently being used.

Absorbent Oils and Natural Gas

Since natural gas appears in probably as many different proportions of constituents as there are occurrences, it seems that the general trend is that there is a preponderance of methane with decreasing proportions of other gases with increasing boiling points.

A hypothetical natural gas has been taken where the occurrence of the hydrocarbons from methane to octane is directly proportional in per cent by weight to the vapor pressures of the respective hydrocarbons. This value is used for a gas containing 0.5 gallons of natural gasoline per thousand cubic feet of gas (including one-fourth of the butane and all of the pentane, hexane, heptane and octane in the natural gasoline). In considering a natural gas containing 2.5 gallons and 5.0 gallons of natural gasoline, respectively, the proportions of the components of the natural gas and natural gasoline fractions, respectively, have been maintained in the same as in the 0.5 gallons gas with the proportions of natural gas and natural gasoline fractions varying in relation to each other.

The characteristics of the three natural gases are shown in Table 3.

Manufacturers in convention at Tulsa, May 5 and 6

Suitable Laboratory For Refinery of Moderate Size

(Continued from page 21)

both sides. All the partitions enclosing the stair hall were made of 6-inch, semi-porous terra cotta partition tile, scored on all sides and plastered. All other tile partitions are of 4-inch, semi-porous, terra-cotta partition tile, also scored on all sides and plastered. All plastering is of smooth finish.

Walls and ceilings were painted a cream white to a level five feet from the floor, at which point they were painted a chocolate brown. The finishing coat was of enamel, thus making the cleaning of the walls more easy. Basement walls, being of concrete, were not painted.

The light oil testing laboratory has four ceiling lights, with switches controlling same placed near each of the two hall doors opening into this room. This laboratory is further provided with four electric wall outlets, conveniently placed, and at a height of about 12 inches above the top of the laboratory tables—all wall outlets in all rooms being at this same height. The heavy oil testing laboratory also has four ceiling lights—one of which is placed in the small flash and fire room —with one switch, placed near the hall door, controlling all lights. The room is further provided with nine electric wall outlets—one of which is in the flash and fire room. The chemical laboratory is provided with two ceiling lights and six wall outlets. The three other rooms of the building and the rear hall each have only one ceiling light, while the main hall of the building is provided with three lights.

Equipment

In furnishing the light and heavy oil and chemical laboratories, standard Kewaunee desks and tables were purchased, but especially built to fit the rooms, and with piping connections to meet the requirements of the work in a petroleum refinery laboratory.

The finishing of all desks and tables is of dark golden oak, and all are equipped with albarene stone tops. All desks are 36 inches high and 30 inches wide. All gas cocks are in the front of the desk, with steam, air, water and vacuum connections in the rear. The desks are further provided with albarene stone drainage troughs in the rear.

Light Oil Testing Laboratory

Conveniently located near the center of the light oil testing room is a special Kewaunee drain table, 3 feet wide by 4 feet long by 3 feet high. The top of this table is lead-lined, and slopes toward the center, at which point is located a lead waste drain pipe. Two-inch mouding surrounds the top of the table. Because this table has proved to be of such great convenience, the details of its construction are shown in Fig. 6. It is used most frequently in emptying sample bottles, washing any glassware or equipment in gasoline, etc.

Another Kewaunee table, 6 feet 9 inches long by 20 inches wide, is placed along the east wall of the light oil testing laboratory, near the dumb-waiter, and on it are placed tested samples until they are ready either for dumping or for storage in the retained sample room.

In the south part of this room—between the two doors—a regular office desk is placed, this being used by the testers and sample boys for clerical work.

Other equipment, in addition to the furniture, includes merely standard distillation equipment, hydrometers, hydrometer jars, color machine, and such miscellaneous chemical glassware as is needed from time to time for efficiently conducting the work.

Heavy Oil Testing Laboratory

Arrangement of the furniture, and the details of its construction, in the heavy oil testing laboratory—including the flash and fire room— is shown in one of the illustrations.

This sketch shows details of the spe-

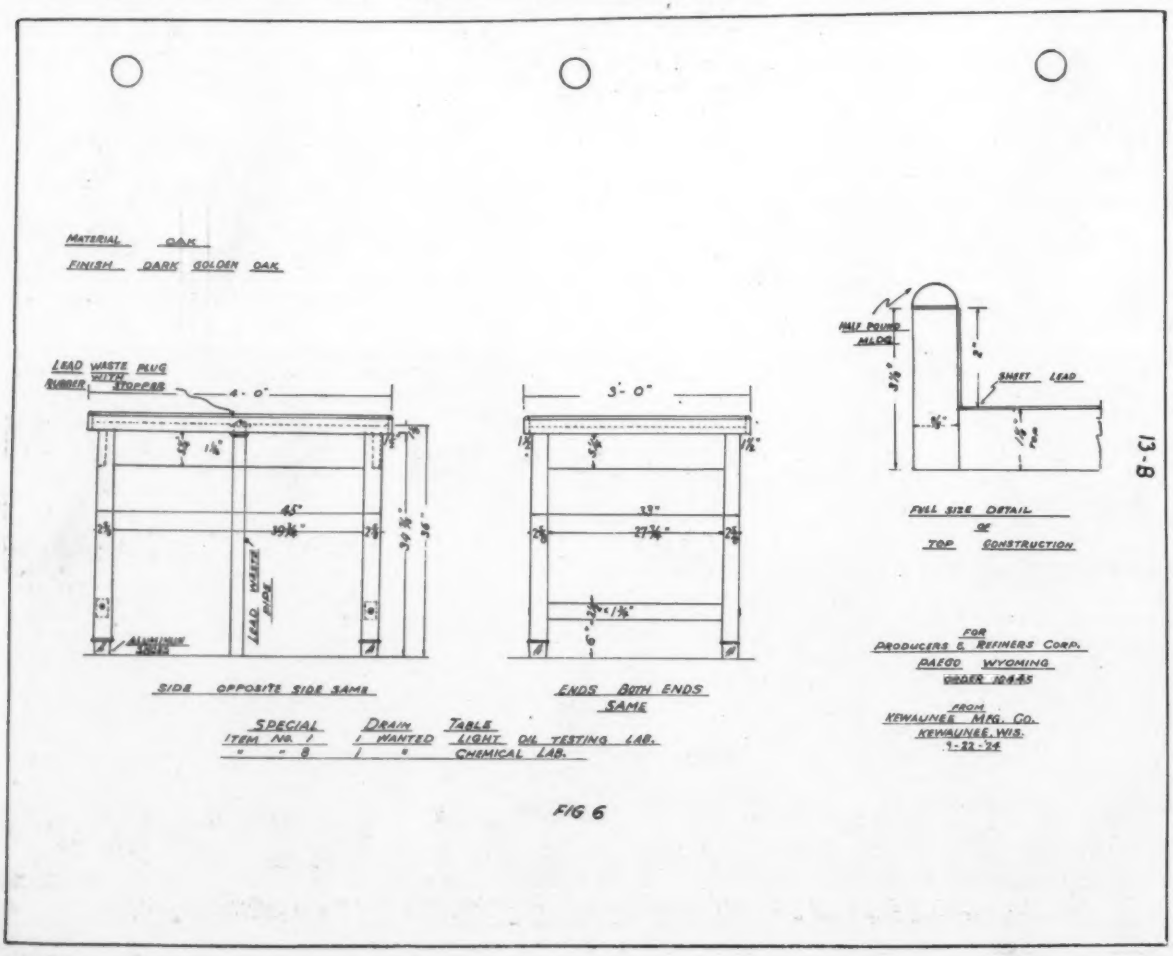
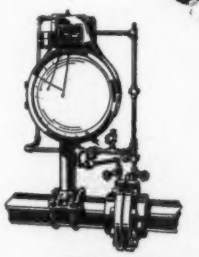
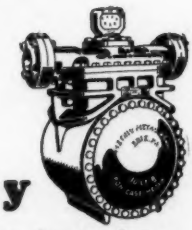


FIG 6

MEASURING THE MID-CONTINENT'S OIL - GAS - STEAM - WATER





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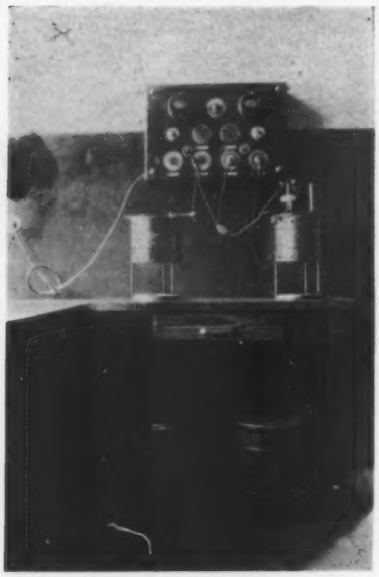


Viscosity Machines and Thermostatic Temperture Control

cial oil drain desk in the southeast corner of the room, this desk being a novel departure from ordinary laboratory furnishings, and proving to be a particular convenience.

One of the tables shown as being used in the flash and fire room has since been removed and placed on the opposite side of the partition in the main part of the heavy oil testing laboratory, where it is used as a "Viscosity-Machine" table. Each of these two tables is 18 inches wide by 42 inches long by 36 inches high.

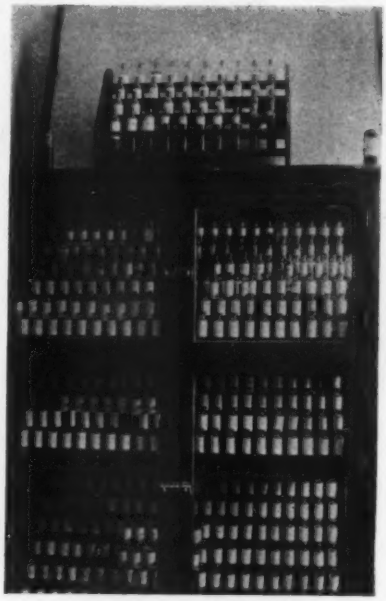
The special-built Kewaunee table on the west side of the flash and fire room is 5 feet 4½ inches long by 18 inches wide by 32 inches high. It is used exclusively for equipment for making flash and fire tests, the tester sitting in front of this table.

Other laboratory equipment in this room includes a centrifuge machine, hydrometers, hydrometer jars, electric oven, Union colorimeter, viscosity machines, and other miscellaneous laboratory equipment and chemical glassware used in the testing of heavy oils.

Chemical Laboratory

Arrangement of chemical laboratory furniture and details of its construction are shown in another sketch, this sketch, as in the case of others, showing also the number and the arrangement of the gas, air, vacuum, water and steam cocks.

A change that had to be made in installing the furniture, because of insufficient space at the place originally designated, was the removing of the oil drain table from the west side of the room along the wall to the center of the room. However, this change has proved very convenient and satisfac-



Sample Case

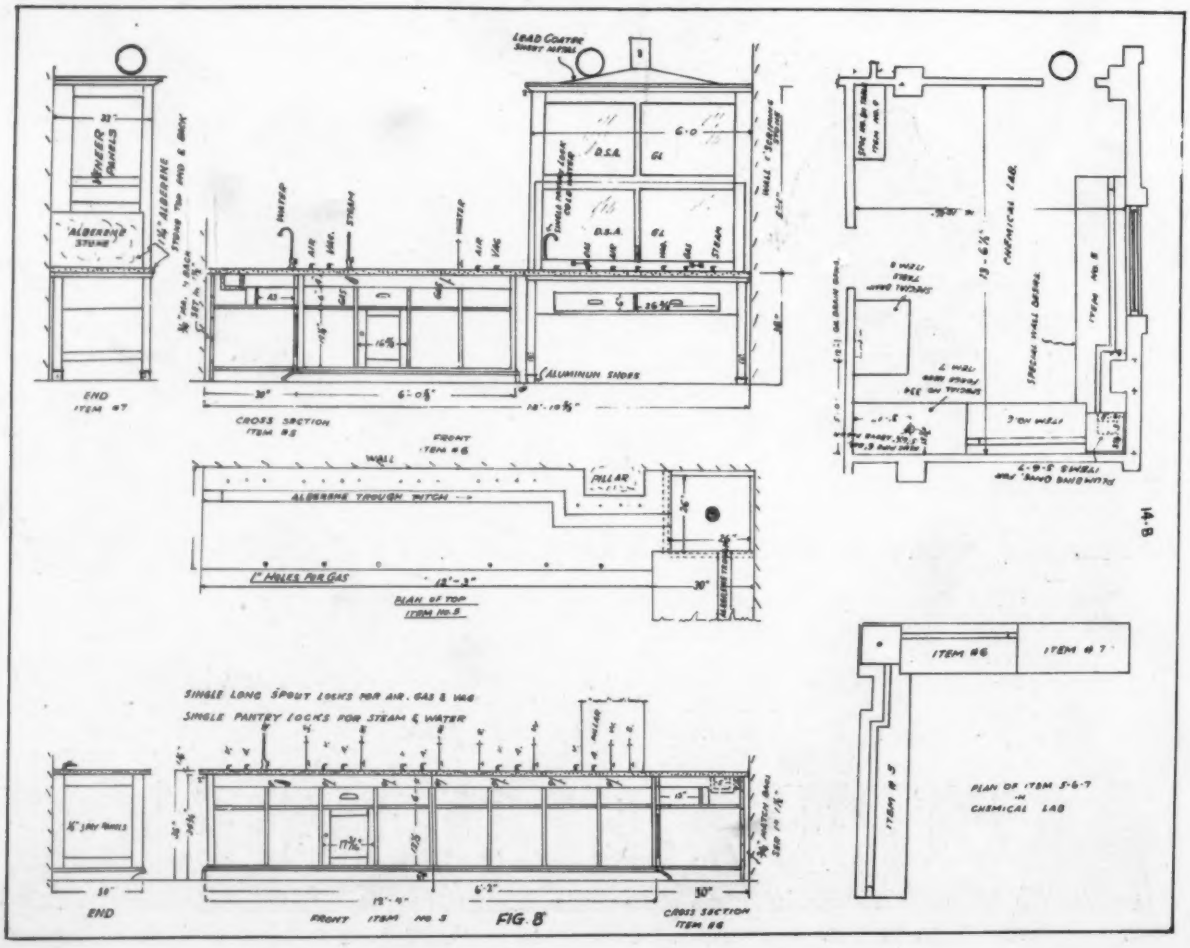


FIG. 8

Pipe Bends for BIG Work!

A complete line of Valves and Fittings in Brass, Iron and Steel for all pressures and purposes is made at our Valves and Fittings Works, Greensburg, Pa. Write for catalogue.

The main arteries in any piping system call for more than usual care in their making.

Any appeal for such work must be based on an ability to produce that knows no compromise. Accurate designing, quality materials, plant equipment to meet modern needs and workmanship of the most experienced kind, all these combine to make K & J stand for everything you will demand in fabricated work of unusually large size.

Estimates furnished on request

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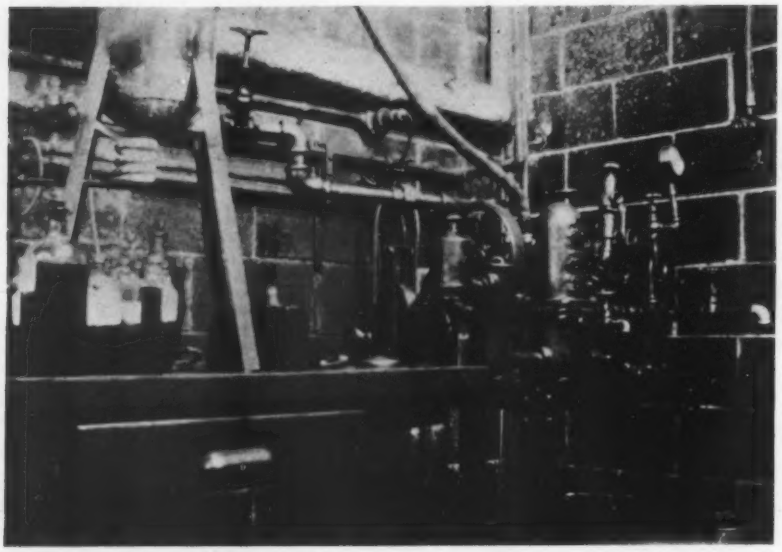
PIPE FABRICATING SHOPS - ETNA, PA.



Shrivers Portable Filter Press

tory. This table is exactly the same as the one used in the light oil testing laboratory.

In addition to the Kewaunee furniture indicated in this room, there is also in use a Kewaunee balance table 4 feet long by 20 inches wide by 30 inches high, which is placed in the extreme northwest corner of the room.

The chemical laboratory is equipped for doing any usual analytical or chemical research work encountered in oil refining. Special equipment includes a specially-built table and equipment for gas analysis; a Parr oxygen-bomb calorimeter and table for same; an electric furnace and supporting table; an electric oven; an air-pressure filter; shelves for reagent and standard solution bottles; a special drain board built over the sink; a special-built case for holding chemicals, samples, glassware, etc.; and such other apparatus and equipment as is needed and is used in analytical and research work.

Stock Room

Along the three walls of the stock room are built shelves—further divided into compartments—and about 60 drawers for "stocking" chemicals, chemical glassware and other equipment used by the chemists and testers in their work. All shelves are built to the ceiling—a ladder being used in reaching the upper shelves.

Experimental Laboratory

The experimental laboratory, located in the basement, is provided with a laboratory desk, fitting along the west side of the room. All furniture in the basement is that which was used in the first plant laboratory during 1923 and the first part of 1924. Three other desks and tables—not built in solid, however—also occupy most of the east side of this same room. All desks have available gas, air, water and steam connections.

Special equipment in this room, and the ones adjoining, includes a Shriver portable filter press, an electric pulverizer, agitators of all sizes, stills and similar equipment for conducting experimental work. A water sink is placed in the east central part of the room.

In addition to this particular research and experimental laboratory, a "shack" located in the northeast part of the refinery is also used at times for investigational work of a special nature.

Wash and Dry Room

The wash and dry room, located in the northeast corner of the basement, is used mostly for washing and drying and the storage of sample bottles. Desk space, however, fills most of the space along the east and south walls of the room, so that experimental work can be conducted in this room if so desired.

A water sink, with drainage boards adjoining, is located in the northwest corner of the room. Here also is located a table for bottles and a still for making distilled water.

Other equipment in this room includes a table along the west side of the dumb-waiter; an oil-drain table adjacent to the water sink along the north side of the room; a third table for bottles next to the oil-drain table and also placed along the north wall; a cupboard for clean bottles and glassware placed along the west-central part of the room, and another cupboard for clean bottles located in the northeast corner.

Sample Room

Shelves, divided into compartments,

(Continued on page 50.)

P. & R. FORM R-152

DATE
SAMPLE OF
FROM
REFERENCE
CAR OR TANK NO.

P. & R. FORM R-152

PRODUCERS & REFINERS CORPORATION

PARCO REFINERY

DATE _____ LAB. NO. _____

SAMPLE _____

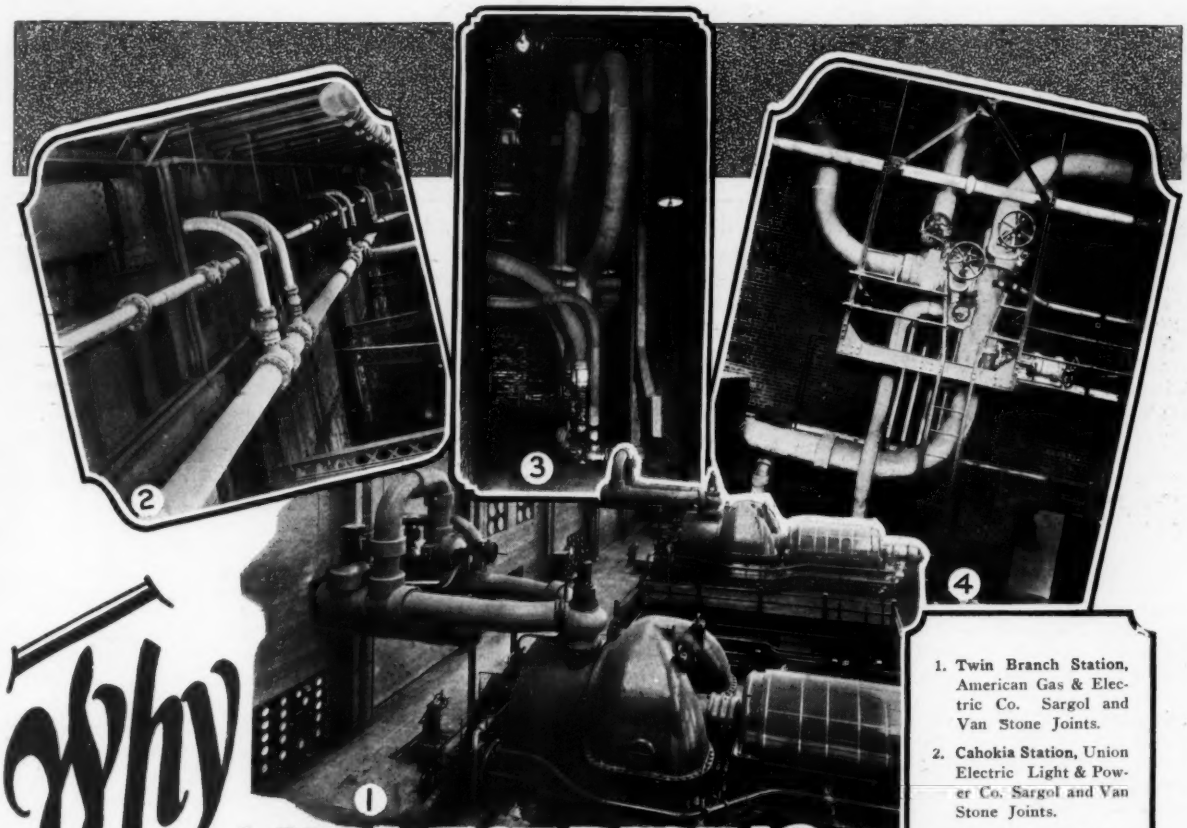
FROM _____

REFERENCE _____

CAR OR TANK NO. _____

OVER

		DISTILLATION	
Gravity		% off	Temp.
Flash Point		I. B. P.	
Fire Test		20	
Viscosity @ 100° F.		50	
" 210° F.		90	
Cold Test		95	
Color N. P. A.		F B P	
" Lovibond			
Emulsion		Temp. Off.	%
Demulsibility		221	
Doctor Test		284	
Sulphur		380	
B. S. & Water		392	
Conardson Carbon Residue		410	
Saponification Number			
Fatty Oil			



Why MIDWEST PIPING in these Central Stations?

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2. **Cahokia Station,** Union Electric Light & Power Co. Sargol and Van Stone Joints.
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BECAUSE—Midwest is thoroughly responsible and stands squarely behind every contract, be it large or small, difficult or simple to fulfill.

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MIDWEST Power Piping

Mention Where You Saw the Advertisement

Proper Design and Operation of Heat Exchangers

By F. L. Kallam, M. E. and A. F. Semino

Production of heat is the most costly single item in petroleum heating. Conservation of heat, once produced, offers opportunity for perhaps the greatest saving in the operation of a refinery or natural gasoline plant.

That is the reason for the development of the heat exchanger in refining circles in the last five years. This development, however, has been haphazard almost as often as it has been scientific.

In this paper Messrs. Kallam and Semino are presenting a treatise on heat conservation in petroleum refining. When completed it will be the most thorough work written on the subject, as restricted to refining.

The series was begun in March and will require three or four issues for completion, after which it will be put in book form.—The Editor.

THE results of 153 separate tests made upon various types of oil exchangers, operating under commercial conditions, are shown graphically in Figures Nos. 6, 7 and 8. In presenting these data, it was decided that it could most conveniently be handled by grouping the various exchanger types according to the type of flow existing in the apparatus at the time of the test. Hence, if the exchanger examined were tested over a range of flow rates, as in the case of one of the multi-tubular admiralty metal tube type, the results would be found upon each of the three curve sheets. For this reason, each of the various group-types of exchangers has been given a number as follows:—

Curve No. 1—Results of tests with double-pipe, standard pipe, exchangers, with the fluids in counter-flow.

Curve No. 1-P.—Results of tests with double-pipe, standard pipe, exchangers, with the fluids in parallel flow.

Curve No. 2.—Results of tests with multi-tubular exchangers, using standard iron and steel pipes, no baffles, the fluids being in counter-flow.

Curve No. 3.—Results of tests with multi-tubular, standard iron and steel tubes, exchangers, employing counter-flow. Exchangers equipped with semi-circular baffles placed at right angles to tubes.

Curve No. 3-S.—Results of tests with exchangers similar to those used for Curve No. 3, but no provision made to assure full submergence of the tubes.

Curve No. 4.—Results of tests with manufactured multi-tubular admiralty metal tube exchangers, using counter-flow. Exchangers equipped with orifice type baffles.

Curve No. 5.—Results of tests with manufactured cross-tube type flow exchangers, utilizing counter-flow.

Curve No. 6.—Results of tests with concentric type of exchangers, constructed of standard iron pipes, employing counter-flow.

Table No. 2 gives a partial summary of the data obtained during the tests, and hence gives an idea of the basis for the curves. Because of the lack of space, it is impossible to include the entire set of tests, but seven, typical of all the tests made, are presented. However, Table No. 3 gives an idea of the ranges covered in these tests.

It is the wish of the authors to emphasize the fact that the "tests" made were performed with apparatus operating under actual topping and absorption plant conditions. In many cases, complete information covering the operation of a piece of apparatus, such as temperatures for various oils and oil rates, was obtained only through months of observation. By this procedure, it was possible to make runs covering a period of several weeks under one set of conditions, thus assuring results representative of general practice. In a few cases this was impossible, and the entire test was performed within a single day. Some tests were even made on apparatus for a single given operating condition only, but when it is considered that exchangers in seventeen plants were investigated, the average of the results developed by such methods can be taken as representative of general operating conditions.

Discussion of Results

Stream-line flow. (Fig. No. 6). The experimental data for stream-line flow admit themselves remarkably well for plotting by the method selected. The data for oils of 16 to 38 degrees Be. gravity, having a viscosity ranging from 36 to 1400 Saybolt Seconds at 100 degrees F., cover very large ranges of velocity, varying from 0.36 to 39.0 feet per minute in the shell and from 3 to 147 feet per minute in the tubes. The value of D_1/D_2 varies from 0.253 to 2.76.

The most surprising, and interesting, feature of Figure No. 6, is the relative position of Curves Nos. 3 and 4. In theory, it would be exactly the opposite of that indicated. However, it is possible that for stream-line flow, the cross tube flow produced by semi-circular baffles promotes better results than the orifice type baffles.

The position of Curve No. 3-S may be explained by the fact that the exchanger was not so installed as to assure it operating full of oil. It is quite possible that only a part of the tubes were submerged, thus lessening the efficiency of the apparatus.

The approximate parallelism of all the curves is worthy of attention. This tends to indicate a constant value for the index of the exponential function of the controlling variables.

Unsteady turbulent flow. (Fig. No. 7). The experimental data for this type of flow covers ranges of velocities varying from 3 to 64 feet per minute in the shell and 21 to 144 feet per minute through the tubes, for oils of 16 to 38 degrees Be. gravity, having a viscisity of 40 to 550 Saybolt Seconds at 100 degrees F. The ratio of D_1/D_2 varies from 0.953 to 2.46.

The relative positions of the curves are according to theory. The exact parallelism of the curves indicates uniform variation of the factors for the different types of exchangers. It is evident that the performance of heat exchangers operating in unsteady turbulent flow might advantageously be expressed by a formula.

It is unfortunate that complete data for unsteady turbulent flow on all types

NOMENCLATURE

A =Mean effective transfer area—Square feet.
c =Specific heat of fluid—B.t.u. per pound per °F.
c_T =Specific heat of hot fluid—B.t.u. per pound per °F.
c_t =Specific heat of cold fluid—B.t.u. per pound per °F.
C =Coefficient of fluid friction loss depending upon W, D_1 and U.
D_1 =Internal diameter of tube—Inches.
D_2 =Shape factor—Inches.
d =Density of fluid—Pounds per cubic foot.
E =Efficiency of heat transfer—Per cent.
F =Crtical velocity factor depending upon V_s, D_2, S and U.
$J = \frac{W_T c_T}{W_t c_t}$ or $\frac{W_t c_t}{W_T c_T}$ (whichever is less than 1.)
k =Overall coefficient of conductivity.
k_e =Coefficient of conductivity of internal liquid film.
k_H =Coefficient of conductivity of external liquid film.
k_T =Coefficient of conductivity of metallic tube wall.
K =Overall heat transfer coefficient—B.t.u./Hr./Sq. ft./°F.

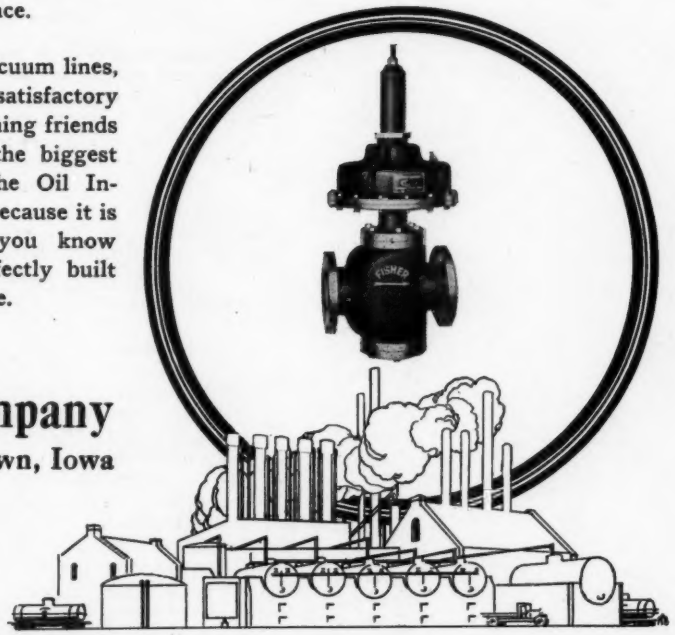
(Continued on next page.)

Ultra Sensitive Vacuum Control

Automatic vacuum regulation to one-half inch of mercury . . . sensitive . . . accurate . . . dependable.

Fisher Vacuum Regulator, Type No. 86, is the only metallic bellows diaphragm regulator made in America. It is the most advanced type of regulator known to modern engineering science.

Used on all vacuum lines, it is doing satisfactory work and winning friends daily among the biggest concerns in the Oil Industry. And because it is Fisher built you know that it is perfectly built . . . dependable.



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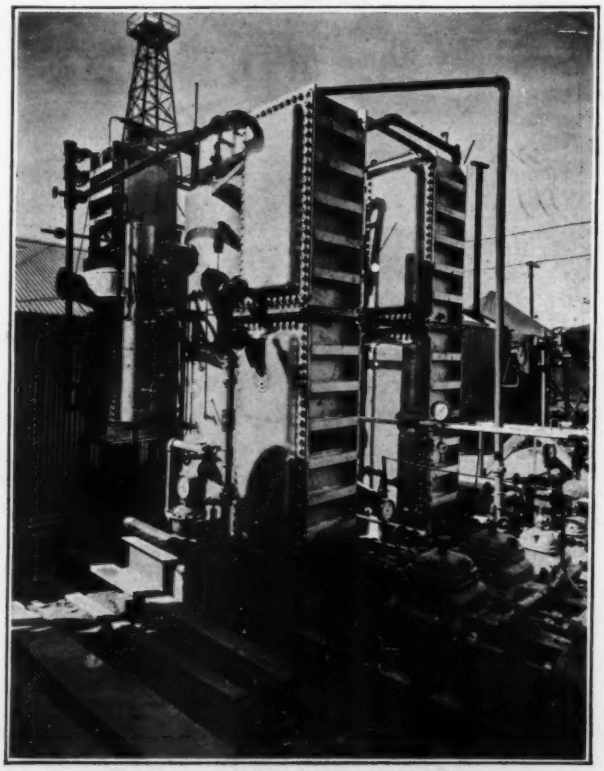
Portable 2,000 gal. distillation unit, assembled on platform, 7½' wide x 16' long x 12½' high. Bubble absorption tower and water cooling tower not shown.



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Two standard SOUTHWESTERN portable units, like the one illustrated, nominally rated at 2,000 gallons gasoline per day each, operating in the Mid-Continent on 3,250,000 cu. ft. each of 1.41 gal. gas, and circulating 60,000 gal. oil per day each, are consistently making a total of over 9,000 gal. per day of 85.5° Be. gasoline.

Several of these units, arranged in parallel, may be effectively employed to handle any quantity of gas available, since the capacity of the plant may be changed by adding or removing one or more units. Portability, combined with SOUTHWESTERN unit type steel plate construction, assures practically 100% salvage value.

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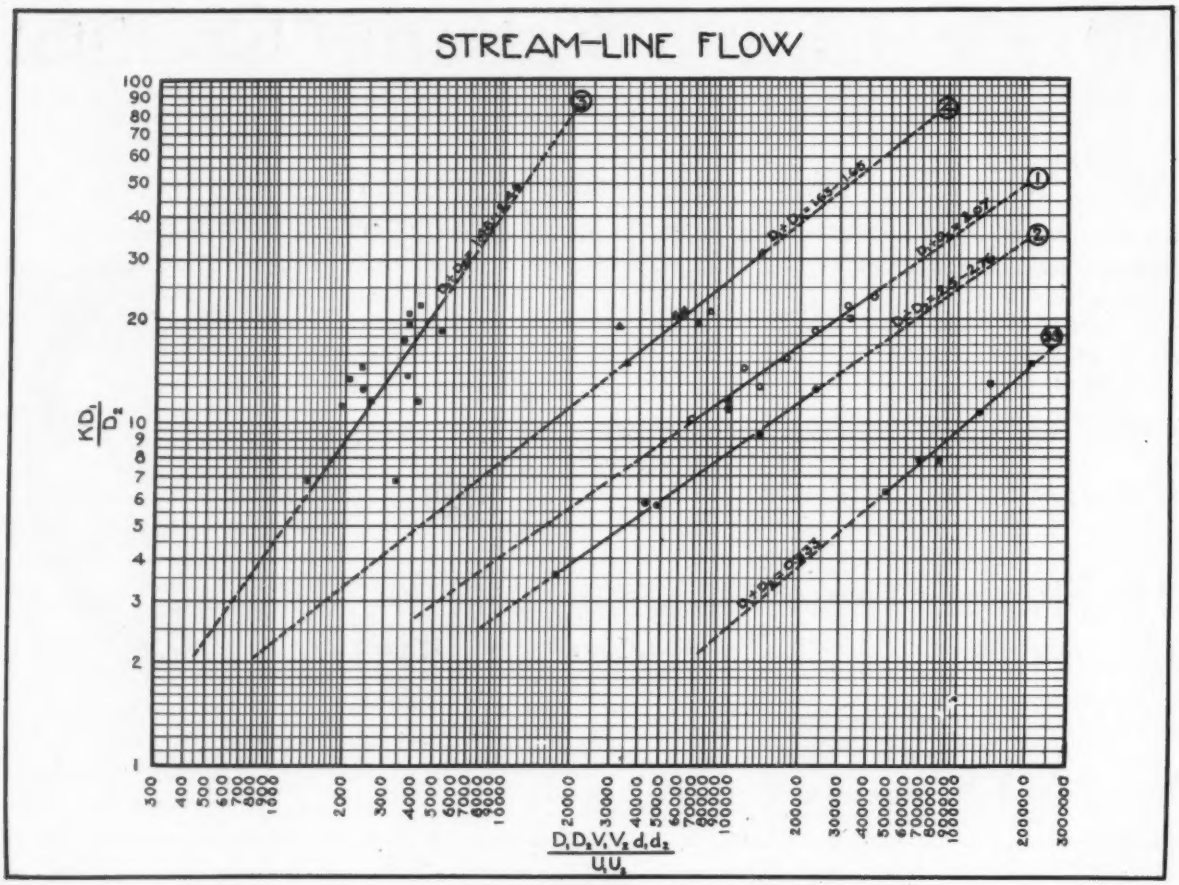

FIGURE 6.

of exchangers were not available. Information which could be derived from a complete set of curves for this type of flow might be of inestimable value.

Steady turbulent flow. (Fig. No. 8). The majority of the experimental tests were performed under conditions of steady turbulent flow. This is encouraging, as it indicates judicious design and operation of the exchangers, since the tests were made under operating conditions.

The data cover tests ranging in velocities of 10 to 116 feet per minute in the shell and 20 to 571 feet per minute through the tubes, for oils of 18 to 37 degrees Be. gravity, having viscosities of 37 to 290 Saybolt Seconds at 100 degrees F. The ratio of D_1/D_2 varies from 0.975 to 5.40.

There are several peculiarities which need explaining. Curve No. 1-P is for double pipe exchangers operating with parallel flow, while Curve No. 1 is for double pipe exchangers with counterflow. These two curves cross, indicating a limited economical range for each condition. However, the experimental range strongly favors countercurrent flow. The greater steepness of Curves Nos. 1 and 2 (high index of variable factor) over the other curves must remain unexplained.

Curve No. 5 is of special interest in that it indicates superior performance of the cross-tube type of flow over the parallel tube type. The general belief that intricate baffling schemes are necessary for maximum heat transfer is refuted by the results represented in Curve No. 5.

The complicated flow accompanying steady turbulent motion manifests itself by the dissimilar arrangement of the curves in Figure No. 8. The parallelism of the curves as found in Figures Nos. 6 and 7 is not so evident in Figure No. 8. However, the results of tests performed with each type of exchangers describe an approximate straight line for each case.

Conclusions

(1). The experimental work per-

L =Thickness of fluid film—Feet.
M =Hourly equipment charge per B.t.u.—Dollars.
N =Cost of recovering one B.t.u.—Dollars.
O =Time—Hours.
P =Pressure drop through pipe—Pounds/Sq. in. per foot of length.
q =Total heat transferred from body of hot oil to body of cold oil.
q_e =Total heat transferred through film on inside of tube.
q_H =Total heat transferred through film on outside of tube.
q_T =Total heat transferred through metal tube wall.
Q =Total heat transferred in heat exchanger—B.t.u./Hr./Sq. ft./°F.
R =Total resistance to flow of heat=$R_e+R_H+R_T$.
R_e =Internal liquid film resistance to flow of heat.
R_H =External liquid film resistance to flow of heat.
R_T =Metallic resistance to flow of heat.
s =Viscosity—Saybolt Seconds.
S =Specific gravity of fluid—Water=1.
t_1 =Temperature of fat (cold) oil entering—°F.
t_2 =Temperature of fat (cold) oil leaving—°F.
T_1 =Temperature of lean (hot) oil entering—°F.
T_2 =Temperature of lean (hot) oil leaving—°F.
T_a =Temperature of body of hot oil.
T_b =Temperature of film of hot oil at tube surface.
T_c =Temperature of film of cold oil at tube surface.
T_d =Temperature of body of cold oil.
Ø =Logarithmic mean temperature difference (M.T.D.)—°F.
U =Absolute viscosity of fluid—Poises.
V =Velocity of fluid—Feet per minute.
V_c =Critical velocity of flow—Feet per second.
V_s =Velocity of fluid inside of tube—Feet per second.
W =Weight of fluid flowing inside tube—Pounds per second.
W_t =Weight of cold fluid—Pounds per hour.
W_T =Weight of hot fluid—Pounds per hour.
X =Value of one recovered B.t.u.—Dollars.
Y =Hourly profit from heat exchanger—Dollars.
Z =Kinematic viscosity of fluid—Poises.

A W-K-M Portable Hydraulic Pipe

Straightening and Bending Machine can save just as much money around a refinery as in any other department of the oil business. Consider this instance:

A refinery superintendent in Oklahoma who has been cutting up his bent pipe for nipples and similar purposes learned of the W-K-M Pipe Straightener. He immediately made a check of the bent pipe of different sizes stacked up around his company's warehouse and machine shop, and found that it totalled 10,000 feet of assorted sizes. Bent, the estimated value of the pipe was 7 cents a foot, or $700. Straightened, he figured it would be worth about 30 cents a foot, or $3,000, a difference of $2,300. Deducting the cost of his W-K-M Straightener, which was $350, this superintendent effected a saving in less than ten days of $1,950.

Moreover, he now has a very valuable machine at all times for bending or straightening pipe, angle iron, rods, and similar materials. Frequently, he uses it as a hydraulic press, the 30,000 pound pressure developed being ample for many purposes.

You should know more about this remarkable machine. Either the coupon below, or your letter head, will bring complete details without obligation of any nature. Send today!

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WEIGHT
1275 pounds

POWER
hand

PRESSURE
30,000 pounds

CAPACITY
8″ pipe and smaller

This machine is entirely self contained and is ready to go to work wherever you place it. Can be skidded, or hauled on wagon or ton truck.

PRICE
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f. o. b. Burkburnett, Texas

Sold through oil field supply dealers in oil fields everywhere

TEAR OFF AND MAIL THIS COUPON

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Houston, Texas.
Please mail full details regarding your Pipe Straightener.

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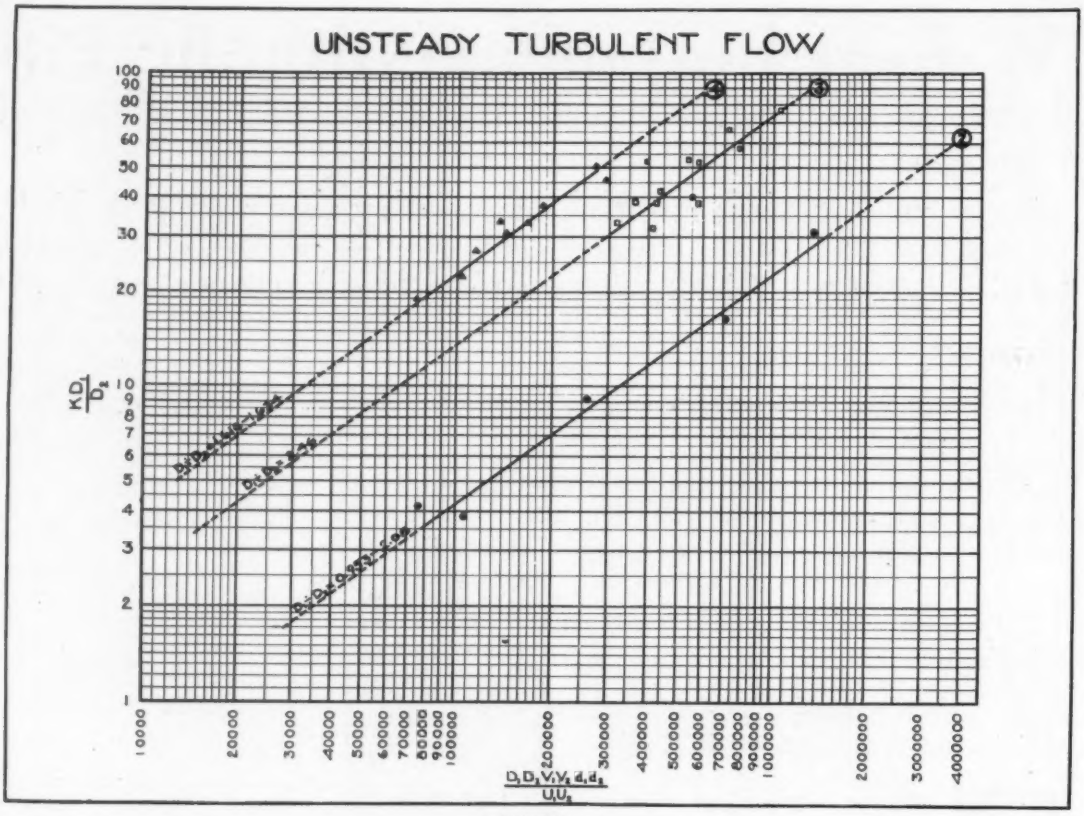

FIGURE 7

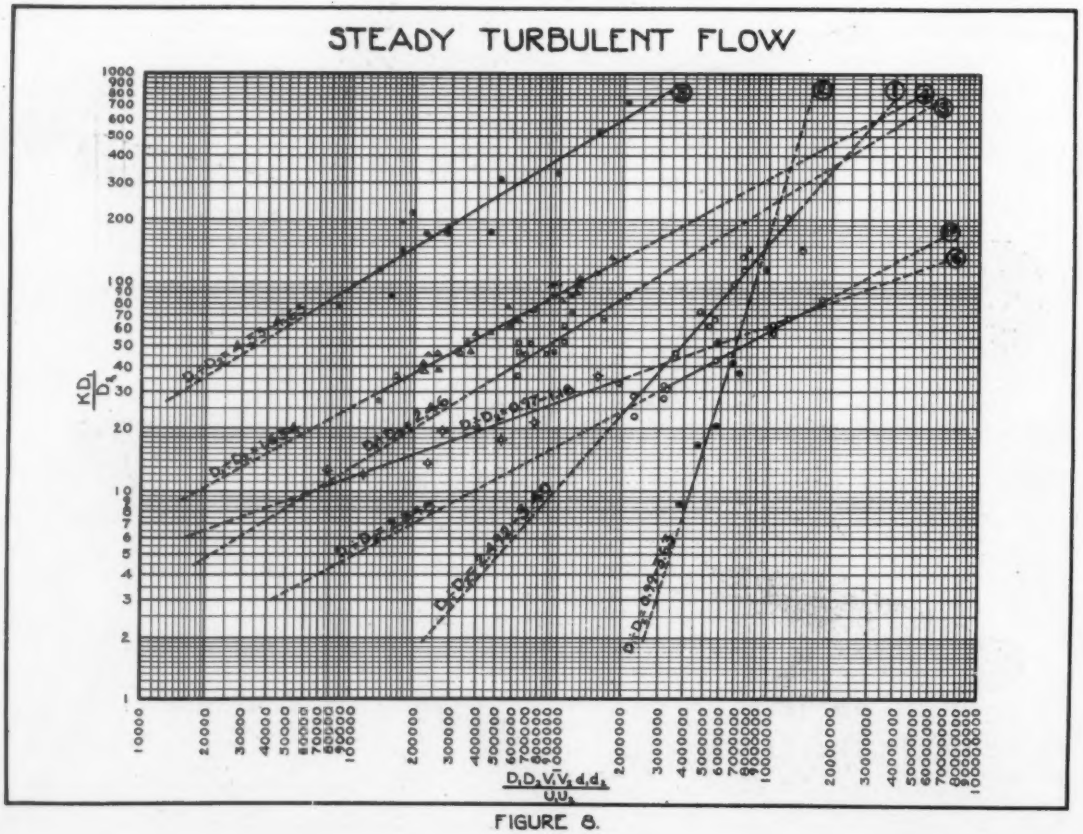

FIGURE 8.

PART SUMMARY OF COLLECTED DATA ON OIL TO OIL HEAT EXCHANGERS.

TYPE OF EXCHANGER	NO. OF EXCHANGER	EXCHANGERS IN PARALLEL	EXCHANGERS IN SERIES	SHELL DIA. INS.	SHELL LENGTH FT.	SHELL MATERIAL	SHELL NO. PASSES	SHELL PRESSURE DROP LBS/SQ. IN.	TUBES NO.	TUBES DIA. INS.	TUBES LENGTH FT.	TUBES MATERIAL	TUBES NO. PASSES	TUBES PRESSURE DROP LBS/SQ. IN.	TURBULENCE PLATES DESCRIPTION	TURBULENCE PLATES SIZE INS.	TURBULENCE PLATES SPACING INS.	TURBULENCE PLATES NO. INS.	TURBULENCE PLATES THICKNESS, INS.
DOUBLE PIPE	1	1	20	12.5	77	STAND. PIPE	1	—	1	6	77	STAND. PIPE	1	—	NONE	—	—	—	—
MULTI-TUBE	2	1	4	18.0	22	¼" PLATE	1	—	56	1	20	STAND. PIPE	1	—	NONE	—	—	—	—
MULTI-TUBE	3	1	1	14.0	63	STAND. PIPE	1	0.6	127	½	60	STAND. PIPE	1	1.0	IRON WIRE	⅛	10'-0" HE	IX	
MULTI-TUBE	4	1	4	18.0	14	CAST IRON	2	—	252	⅝	10	NO. 18 ADMRTY.	6	—	¼" ORIFICE, BRASS	18	4	28	⅛
MULTI-TUBE	4	1	2	18.0	14	CAST IRON	2	—	252	⅝	10	NO. 18 ADMRTY.	6	—	¼" ORIFICE, BRASS	18	4	28	⅛
CROSS-TUBE	5	1	3	30x30	30"	CAST STEEL	1	—	3396	¾	2¼	NO. 16 ADMRTY.	60	—	NONE	—	—	—	—
CONCENTRIC	6	2	1	10.0	69	STAND. PIPE	1	3.5	6,6,5 & 3	¾	75	STAND. PIPE	1	3.8	NONE	—	—	—	—

LEAN OIL G.P.HR.	LEAN OIL VEL. FT/M V_1	LEAN OIL GRV. Bé'	LEAN OIL VIS. SAY @ 100°F	LEAN OIL SP.HT.	FAT OIL G.P.HR.	FAT OIL VEL. FT/M V_2	FAT OIL GRV. Bé'	FAT OIL VIS. SAY @ 100°F	FAT OIL SP.HT.	TEMPERATURES LEAN OIL IN °F T_1	TEMPERATURES LEAN OIL OUT °F T_2	TEMPERATURES FAT OIL IN °F t_1	TEMPERATURES FAT OIL OUT °F t_2	OIL IN TUBES	TOTAL MEAN HEATING SURFACE SQ.FT	B.T.U. TRANSFERRED PER HOUR	M.T.D. °F	K.	LEAN OIL AVE. TEMP. T	LEAN OIL SP. GRV. @ T	LEAN OIL ABSLT. VISCOSITY
10800	39.2	16.2	12.00	0.4	12480	137.0	18.0	555	0.58	400	204	38	140	FAT	2552	5820000	209.6	10.90	302	0.675	6.0
4760	8.9	28.4	50	0.5	4920	31.5	29.8	48	0.5	276	190	60	160	FAT	1385	1380000	113.8	8.80	233	0.823	1.55
12920	56.8	32.2	43	0.5	13300	112.0	33.9	41	0.5	198	157	84	121	FAT	1455	1755000	75.1	16.00	178	0.822	2.05
6933	243.0	24.0	58	0.5	7250	26.8	26.9	53	0.5	204	128	67	143	LEAN	1520	1997000	61.0	21.60	166	0.874	3.30
5355	20.7	31.1	47	0.5	5520	194.0	32.2	45	0.5	297	188	128	228	FAT	760	1988000	64.6	40.50	243	0.806	1.40
23000	361.0	30.7	54	0.5	23500	22.9	31.9	51	0.5	290	162	136	238	LEAN	4212	10700000	37.5	66.70	226	0.815	1.80
4670	60.0	26.6	48	0.5	4740	63.1	28.0	44	0.5	272	139	65	201	LEAN	1477	2319000	72.9	21.60	206	0.845	1.85

FAT OIL DENSITY d @ T	FAT OIL AVE. TEMP. T	FAT OIL SP. GRV. @ T	FAT OIL ABSLT. VISCOSITY U	FAT OIL DENSITY d @ T	D_1	D_2	$D_1 D_2$	$V_1 V_2$	$U_1 U_2$	$d_1 d_2$	$\frac{D_1}{D_2}$	$\frac{D_1 D_2 V_1 V_2 d_1 d_2}{U_1 U_2}$	$\frac{KD_1}{D_2}$	VEL. F/SEC. V_s	KINEMATIC VISCOSITY N	$\frac{D_1 V_s}{Z}$	TYPE OF FLOW
54.6	89	0.910	1.6	56.8	6.070	2.928	17.75	5400	960.00	3105	2.07	310 000	22.6	2.285	1.760	7.89	STREAM LINE
51.3	120	0.857	4.26	53.5	1.050	0.770	0.810	282	6.58	2745	1 36	95 250	11.96	0.524	0.496	11 80	STREAM LINE
51.3	103	0.842	3.55	52.5	0.620	0.252	0.150	6360	7.28	2692	2.46	366800	39.40	1.866	0.042	27.40	UNSTEADY TUR
54.6	105	0.877	6.10	54.8	0.527	0.323	0.170	6520	20.15	2990	1.63	164500	3530	4.050	0.038	56.50	STEADY TUR.
50.4	178	0.823	2.20	51.4	0.527	0.323	0.170	4020	3.08	2585	1 63	572500	66.15	3.232	0.027	63.80	STEADY TUR.
50.8	187	0.821	2.30	51.3	0.652	0.140	0.091	8730	4.14	2605	4 65	500000	310.00	6.350	0.022	187.00	STEADY TUR.
52.8	133	0.863	3.20	53.8	0.640	0.656	0.042	3784	5.92	2840	0.98	763000	21 05	1.267	0.022	205.40	STEADY TUR

TABLE 2.

RANGE OF OIL EXCHANGER TESTS.

APPLYING TO FIGURES 6, 7, & 8

NUMBER OF CURVE	FLOW VELOCITIES SHELL FT/MIN.	FLOW VELOCITIES TUBES FT/MIN.	GRAVITY OF OIL °BE'	VISCOSITY OF OIL SAY. SECS.	SPECIFIC HEAT OF OIL.	TEMPERATURE RANGE LEAN OIL °F.	TEMPERATURE RANGE FAT OIL °F	RATIO $\frac{D_1}{D_2}$	HEAT TRANSFER COEFFICIENT B.T.U./SQ.FT. °F/HR.
STREAM-LINE FLOW									
1	0.2– 39	82–137	16–18	550-1400	0.4-0.58	410–167	38–145	2.07	6–11
2	0.3– 10	0.4-68	16–38	42–545	0.36-0.5	450–115	72–260	0.25–2 76	2–15
3	0.8– 3	3– 77	24–32	36– 46	0.4–0.56	377–138	65–220	1.48–2.46	1.5–13
3-S	24.0– 29	122–147	32–35	43– 46	0.5	292–199	80–173	0.33	19 –33
4	12.0– 16	109–146	31–32	45– 47	0.5	550–120	80–300	1.63–165	11 –19
UNSTEADY TURBULENT FLOW.									
2	3.0– 22	21– 76	16–38	55–550	0.36-0.5	440–166	80–262	0.95–2.08	2 –12
3	52.0– 64	104–126	32–34	40– 43	0 5	322–133	78–228	2.46	13 –24
4	100– 34	98–144	31–32	45– 47	0.5	306–140	88–223	1.62–1.63	17 –28
STEADY TURBULENT FLOW.									
1	480–116	63–162	29–36	41– 48	0 5	315– 68	36–232	2.49-5.40	6–37
1-P	250– 50	66–132	32–35	38– 44	0.5	303–171	78–169	2.35	12 –28
2	20.0– 95	50–214	18–35	39–290	0.4-0.5	405–125	76–259	1.00–3.63	5–31
3	49.0– 64	97–126	32–34	40– 43	0.5	322–142	84–232	2.46	18 –29
4	13.0– 60	119–571	24–37	41– 58	0.5	316–118	67–240	1.63	22–61
5	10.0– 25	20–381	28–33	37– 50	0.5	317–154	96–270	4.53-4.65	19–109
6	22.0– 60	24– 63	27–29	44– 48	0.5	272–114	64–201	0.98–1.18	11 –22

TABLE 3.

formed with oil exchangers substantiates theory inasmuch as the heat transfer rate has been shown to be dependent upon the state of motion of the fluid, and the arrangement and condition of the transfer surface. The general assumption that K varies solely at some function of the fluid velocity is basically incorrect. The physical characteristics of the operating fluid, as well as its velocity, govern heat exchanger performance.

(2). Since heat transfer takes place between two fluids through a metallic surface, it is necessary to consider the characteristics of the two liquids, as well as the surface arrangement. For any particular type of exchanger this may be done by plotting $K\ D_1/D_2$ against $D_1D_2V_1V_2d_1d_2/U_1U_2$. This method has been found to illustrate satisfactorily the performance of heat exchangers without considering the complicated and impracticable theory of the film concept.

(3). The accumulation of foreign matter upon the metallic transfer surface of all exchangers with length of service causes a continuous variation in the fluid film thickness. Hence, calculations involving this factor in predicting exchanger performance may be in error by as high as 50 per cent.

(4). Counter-current flow gives a higher heat transfer efficiency than parallel flow, though there are certain isolated cases in which the use of the latter type of flow would be justifiable.

(5). The flow within the tubes should be in turbulent motion, or when D_1V_s/Z is equal to or greater than 25, and preferably in steady turbulent motion when D_1V_s/Z is greater than 40. However, turbulent motion should not be produced at the expense of excessive pressure drop.

(6). Where turbulent flow within the shell is accomplished by mechanical means, such as baffle plates, either the hot or cold oil may be circulated around the tubes without impairing the transfer efficiency. Where, however, turbulence plates are omitted, the hot oil should be circulated within the tubes. Contrary to general belief, the turbulence within the shell necessary to attain high heat transfer, may be accomplished at a lesser pressure drop by employing the cross-tube flow.

(7). The Thermal conductivity of the metal composing the heating surface has little, if any, influence upon the heat transfer efficiency of the heat exchanger.

(8). Providing that the horizontal heat exchanger is properly designed and installed, there is no advantage in placing the exchanger in a vertical position.

(9). The pressure drop through the tubes of an exchanger may be computed approximately by the use of the formula, $P = 2\ C\ W^2/d\ D_1^5$. Experience, and accumulated data on similar apparatus, are the only means available for predicting the pressure drop through the shell. It is advisable, in order to attain the highest heat transfer rate, to utilize the allowable pressure drop in creating turbulent motion.

(10). Providing fundamentals of correct exchanger design are adhered to, the so called "home-built" exchanger can be developed to a competitive plane, in regard to efficiency and cost, with the manufactured types.

(11). The fundamental requirements of good heat exchanger design are:

(a). The exchanger must be designed and built to meet specific operating conditions.

(b). The desired temperature for the oils handled must be realized. This can be accomplished by correct arrangement of the heating surface, distribution of flow conditions of the fluids. Generally, for low capacities, the double pipe exchanger will be found most suitable, but for all other flows, the multi-tubular is the logical selection.

(c). The friction drop through the exchanger must not be excessive. The maximum allowable drop should be utilized for creating turbulence. This drop is dependent upon:

1. The available pressure head.
2. The cost of power for pumping.
3. The cost of pumping equipment.

(d). Both the inside and outside of the tubes must be readily accessible for cleaning.

(e). Expansion due to temperature differences must be provided for, to prevent rupture of the exchanger. This can be accomplished by the use of short tubes or a floating tube sheet. The use of tube ferrules, unions or packed joints are to be avoided.

(f). The nozzle arrangement should be such that interconnecting piping is facilitated and by-passing simplified.

(g). Provision should be made for the proper venting and draining of both the tubes and the the shell of the exchanger. Connections for wash-out lines are also recommended.

(h). The tubes should be of small diameter, promoting high velocities, and preferably should be rolled into the tube sheets.

(i). Provision should be made for measuring both the oil temperatures and pressures. In this way, data may be gathered which will eventually lead to greater improvements in the field of exchanger design.

(j). The material of construction must be such as to withstand hard service over a reasonable length of time.

(k). The exchanger first cost must be reasonably low.

Suitable Laboratory For Refinery of Moderate Size

(Continued from page 42)

are placed along three sides of the sample room. These shelves are built to the ceiling. Each compartment will hold about 60 round, quart sample bottles. There are a total of 93 compartments. As samples of each day's shipments are kept in separate compartments, this arrangement provides for the keeping of all samples for three months. The bottom compartments are 2 feet high, so that 5-gallon samples can be stored in this place.

Personnel

From five to nine persons constitute the laboratory organization at the Parco refinery during the past three and one-half years; of this number, from two to four have been graduate chemists, and from three to five others have served as testers and sample boys. At present, the laboratory force is composed of five employes, two of whom are graduate chemists.

Laboratory sample tag shown herewith is attached by the sample boy to each sample just as soon as it is brought into the laboratory. The sample boy also dates the tag, gives it a number (numbers run consecutively, using one series of numbers for processing and special samples and another series of numbers for samples of shipments), and, in addition, writes on the tag a description of the sample, the tank or car from which the sample was taken, and any other similar related information that might be needed.

At present, all laboratory work at the Parco refinery has been divided into two divisions: a chief tester, E. C. Schalk, is in charge of and responsible for all the routine testing and control work of the refinery; while a chief experimental chemist, J. B. Mull, is in charge and responsible for all analytical, research and experimental work that is carried out.

The general lay-out of the first floor and basement of the laboratory and office building described in this article was planned by the writer, assisted by I. A. Clark, who is now employed in the research department of the Mid-Continent Petroleum Corporation.

Biddle and Drake Open Office in Tulsa

Tulsa, Oklahoma.—A. G. W. Biddle, formerly in charge of the office of the Gasoline Department of the Texas Company and R. W. Drake, formerly superintendent of the Gas Department of the Tidal Oil Company, have opened joint offices in the Atco Building, Tulsa.

They are equipped to handle any kind of gas and gasoline testing, to set, repair and prove meters, and make distillation tests. Mr. Biddle is specializing in chart reading and audits, while Mr. Drake will give his time to field work.

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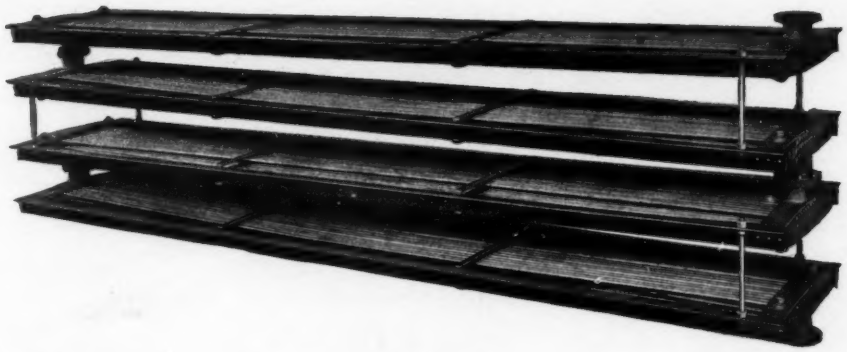

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Gasoline Manufacturers Ready to Push Their Product

Further scientific development and educational campaign result from annual convention

By Grady Triplett

EVERSHADOWING the routine events of the annual convention of the Association of Natural Gasoline Manufacturers in Tulsa, May 5 and 6 was the evident intention of the organization as a body and the members individually to carry their product before the refining and marketing divisions of the petroleum industry as a fuel essential to economy in furnishing gasoline to the public.

That natural gasoline, as well as other gasolines, has anti-detonating properties in automobile motors was brought before the convention by Dr. G. G. Brown of the University of Michigan. His talk was a report of experiments conducted at that school by Dr. E. H. Leslie and Dr. Brown. The complete paper was not ready for the convention but lantern illustrations were used to give those at the convention a chance to follow the methods and results obtained in the work.

The one conclusion drawn from these was that under certain proportions and under certain conditions, natural gasoline, blended with straight run or cracked gasoline, serves to overcome the knocking in automobile motors.

It is from this that the Association proposes to work out an educational campaign, which will present these facts to both refiners and sellers of gasoline. The experiments of Dr. Brown and Dr. Leslie were only the beginning of laboratary work that will be made to gather other facts for presentation to the whole petroleum industry.

The convention in Tulsa further assured members of the Association of Natural Gasoline Manufacturers that they have a product essential to the economic production of motor fuel.

Out of that will grow the method by which that will be carried before other divisions of the petroleum industry, while further experiments will be conducted to learn still other facts that may be used in presenting natural gasoline to its users on its own merits.

In keeping with precedent, E. L. Peck, general manager of the Empire Gasoline Company, was re-elected president of the organization. The Association, now in its sixth year, has had but three presidents. W. M. Welch served two terms, as did D. E. Buchanan.

All vice-presidents were re-elected. They are F. L. Chase, vice-president of the Lone Star Gas Company of Dallas; A. M. Ballard, general manager of the Sun Oil Company of Tulsa; and F. E. Rice, superintendent of the natural gasoline department of the Phillips Petroleum Company at Bartlesville.

A. V. Bourque, who has served in that capacity since a few weeks after the organization was formed, has been re-elected to the post of secretary and treasurer. His report, read during the convention, showed the association in excellent condition financially and growing in membership.

E. L. PECK
re-elected president of the Association of Natural GasolineManufacturers

Roster Growing

Despite the loss of seven members through consolidations in the past year, company memberships show an increase. During the year, the following concerns were added as members: Roxana Petroleum Corporation, Kirt & McDermott, Burrell Oil & Gasoline Company, California Gasoline Corporation, Owen Gasoline Company, General Petroleum Corporation, Standard Oil Company of California, The Henderson Company, Waggoner Refining Company, Inc., Boudinot Corporation, Gasoline Recovery Corporation, Producers Gasoline Corporation, and the Virginian Gasoline Company.

Places on the board of directors are filled by selecting company memberships by the association. The companies in turn select the men to represent them. The following companies have the opportunity to name directors: Amerada Petroleum Corp., Carbide & Carbon Chemicals Corp., Pacific Gasoline Company, Phillips Petroleum Co., Skelly Oil Co., Texas & Pacific Coal & Oil Co., Tidal Refining Co., Roxana Petroleum Corp., General Petroleum Corp., Henderson Gasoline Co., Burrell Oil & Gasoline Co., Eagle Picher Lead Co., and the California Gasoline Co.

F. L. Chase, vice-president, was in the chair for the first session of the convention. After the president's annual address, the report of the gas testing committee was read by George P. Bunn of the gasoline department of the Phillips Petroleum Company. Discussion of this report brought remarks from R. V. Cameron of the Pacific Gasoline Company; J. A. Campbell, consulting engineer of Long Beach, Cal.; George L. Ratcliffe of the General Petroleum Corporation, and D. E. Foster of Tulsa.

Papers Read

Those attending the convention were guests of West-

Officials and directors of the Association of Natural Gasoline Manufacturers assembled for luncheon at the Mayo Hotel during the fifth annual convention in Tulsa. Reading around the table from left to right; E. L. Feck, Empire Gasoline Company, president; A. M. Ballard, Sun Oil Company, vice-president; J. M. Hall, Oil State Gasoline Company, director; E. R. Lederer, Texas Pacific Coal and Oil Company, director; R. I. Short, Prairie Oil and Gas Company, director; W. N. Corbett, Eagle Picher Lead and Zinc Company, director; A. W. Bourque, secretary; F. L. Chase, Lone Star Gas Company, vice-president; A. J. Schlosser, Barnsdall Oil Company, director; H. A. Trower, Phillips Petroleum Company, director; S. C. Carney, Roxana Petroleum Company, director; B. A. Whitney, Transcontinental Oil Company, director and O. H. Schoenwald, Wentz, Oil Corporation, director.

A. M. BALLARD
Vice-president of the Association of Natural Gasoline Manufacturers

F. L. CHASE
Vice-president of the Association of Natural Gasoline Manufacturers

cott & Greis of Tulsa for a cafeteria style lunch at the Mayo Hotel. This was served the first day.

In the afternoon A. B. Morris of the Chestnut & Smith Corporation presented his paper, "Depreciation and Depletion of Natural Gasoline Plants." Discussion brought remarks from H. E. Rorschach, W. M. Welch, George P. Bunn, J. H. Stewart.

The next paper was by Arthur L. Davis of the Empire Refineries, Inc., whose subject was "Research on Absorption Oil."

Discussion was led by A. F. Maxson of the Sun Oil Company. Remarks were made by Dr. E. R. Lederer of the Texas Pacific Coal & Oil Company, J. A. Campbell, A. M. Ballard and W. M. Welch.

W. R. Boyd, Jr., assistant counsel of the American Petroleum Institute, presented a paper, "Industrial Solidity."

"The Economic Value of Natural Gasoline," was the subject of a paper by Dr. E. R. Lederer, vice-president of the Texas Pacific Coal & Oil Company.

Entertainment

Dr. G. G. Brown of the University of Michigan presented the subject, "Relation of Volatility to Acceleration and Anti-Knock Qualities of Natural Gasoline." The experiments were the joint work of Dr. Brown and Dr. E. H. Leslie of the same school.

This subject was presented by lantern slides. The results of the experiments showed natural gasoline to have anti-detonating qualities when blended with straight run gasoline, under certain percentages of blending and certain conditions of operating.

Another paper on anti-knock qualities of natural gasoline was prepared by Ludlow Clayden of the Sun Oil Company at Philadelphia and read before the convention by A. M. Ballard of the same company.

Discussion on both these papers was led by G. G. Oberfell, research engineer of the Phillips Petroleum Company at Bartlesville.

A. V. BOURGUE
Secretary of the Association of Natural Gasoline Manufacturers

F. E. RICE
Vice-president of the Association of Natural Gasoline Manufacturers

Quotation from opinion of Mr. Walter C. Teagle, President, Standard Oil Company (N. J.), before the Federal Oil Conservation Board at Washington, D. C., February 10th and 11th, 1926:

(From the official record as printed by the Government Printing Office, Washington)

"Refinery operations over the past three years are illustrative of the economic tendency I have described.

"Gasoline was produced more cheaply from cracking than from the initial distillation of the crude, and in this way by utilizing only distillates 144,000,000 barrels of cracked gasoline were produced.

"To have produced this 144,000,000 barrels of cracked gasoline from the initial distillation of crude, on the basis of the average yield reported by the Bureau of Mines, would have necessitated the running of 585,000,000 barrels of crude.

"Thus the cracking process dur-

ing the past three years actually conserved this 585,000,000 barrels of crude which is in excess of the total quantity of crude now in storage in the United States."

(Italics used are ours)

Universal Oil Products Company
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Chicago, Illinois

The Economic Value of Natural Gasoline*

Use as a blend permits meeting of gasoline grades and specifications demanded by regulations and users

By E. R. Lederer
Vice President The Texas Pacific Coal & Oil Co.

THE economic value of natural gasoline to the refiner and to the consumer of motor fuel is extremely important. The enormous increase in the demand for gasoline during the last decade had to be met by the use of heavier fractions from the crude and by the rapid development of cracking processes. The products from both of these operations require a great percentage of natural gasoline to supply the necessary lower boiling fractions to blend them into a satisfactory motor fuel and meet the present specifications for U. S. Motor gasoline.

The ever increasing demand for motor fuel can be met—considering the continual decline of available light gravity crude with a large content of natural or straight run gasoline—only by installation of more and more cracking units, in order to convert heavy crudes or the heavier residues or fuel oil into gasoline. As long as this condition exists the manufacture of natural gasoline will be an important factor in the petroleum industry. In these days of close margins of profit the refiner can sell his light fractions to better advantage blended with a certain percentage of natural gasoline, than he could selling straight run or cracked gasoline alone; he can by proper blending—produce from the same crude several grades of gasoline like 56-58 U. S. Motor or 450-E. P. gasoline; 58-60 U. S. Motor or 450 E. P. gasoline; 60-62 grade or 64-66, and 68-70 or 70-72 gasoline, the latter grades especially for export, which permits him to adapt his production to market conditions.

Value for Blending

Such variety of grades and quick changes in refinery operations would be impossible if he could not revert to blending with natural gasoline. Natural gasoline is, therefore, very widely used by the refiner in the manufacture of motor fuels and enters to the amount of 40 or 50 per cent in certain blends. This is particularly true in the blending of the lighter gravity gasolines for which there is a large demand in certain sections of the country, and also an increasing export demand. The use of natural gasoline is essential to the refiner in order to obtain maximum returns for his products.

*Read before the annual convention of the Association of Natural Gasoline Manufacturers, May 6, 1926.

The demand for high test gasoline in cold weather for both domestic and export bussiness usually offers profitable business to the refinery. Naturally the demand for natural gasoline has increased in proportion to the demand for motor fuel for domestic or export trade and the natural gasoline industry has grown in a few years from comparative insignificance to an important economic factor.

We have today probably 1200 natural gasoline plants in the United States, with an approximate capacity of 4,500,000 gallons a day, and the consumption of over 1,100,000,000 gallons natural gasoline during 1925 proves clearly the value and demand for this product.

Statistics of the Bureau of Mines for 1925 show that the demand for motor gasoline was met as follows: Straight run gasoline, 67 per cent; cracked gasoline, 26 per cent; natural gasoline, 7 per cent. This figure of "7 per cent of the entire gasoline production of the country" might at first look small; however, it does not represent the relative importance of this product to the refining industry. Doctor Burrell states in his recent book that "natural gasoline makes satisfactory for motor fuel a quantity of gasoline equal to at least 20 per cent of the motor fuel of the country."

Permits Capacity Refining

Recently we have heard quite a bit of discussion about the possibility that increased cracking would decrease the quantity of natural gasoline needed for blending and that "light" cuts could be made off the "crackers" if the necessary fractionating equipment would be installed in connection with the cracking units. It is entirely possible to make specification motor fuel in a modern cracking installation, but the refiner usually finds it more economical to operate at a maximum capacity, paying more attention to maximum yields and depending on natural gasoline to supply the lower boiling fractions in the production of the proper motor fuel.

In making such "light" cuts directly from the cracking units the refiner saves probably some treating expenses, but decreases the value of the balance of the gasoline distillate. No cracking process produces light hydrocarbons of the same boiling point or of a "close cut" nature, but it produces hydrocarbons of quite different boiling points simultaneously—according to pressure and temperature applied—and the high end point products of 437 or 450 E. P. must be taken out with the low end point groups of 375 to 400 E. P.; or must be refluxed or recycled and cracked over again in an attempt to produce low end point distillates only.

This would require pressures and temperatures in excess of those necessary to crack kerosene or light gas oils, and this has so far proven impractical and uneconomical. The refiner who separates this light gasoline from the cracked gasoline distillate obtains a heavy naphtha distillate, which has to be treated heavily and rerun and separated into naphtha and gas oil. In order to convert this heavy naphtha into a marketable motor fuel he has to blend it with a much higher percentage of natural gasoline or sell the low gravity out at a sacrifice. It is clear that such a procedure in fractionation—even if of advantage in some cases to the refiner—is not reducing in the long run the total amount of natural gasoline needed for blending.

Aid to Refining

Natural gasoline has had considerable and economically important influence in changing the former methods of distillation and fractionation in refinery practice. If a crude was deficient in low boiling point hydrocarbons, the gasoline cut had to be made at such temperatures that the mixture of all fractions or the resulting gasoline had the proper gravity, initial and intermediate boiling points required by existing specifications. Thus frequently 10 per cent and more of the lighter fractions or naphtha had to be sold at a lower price than gasoline. Now, with the improved type of fractionating columns the refiner can regulate his cut for the highest end point allowed by the specifications and make up for the lack of lighter hydrocarbons, by blending with natural gasoline and produce a much larger yield of good motor fuel, which will meet all specifications and requirements. It is, therefore, possible, by proper blending, to utilize and increase the value of heavier hydrocarbons which often amount to from 10 to 20 per cent of the crude.

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method of grading gasoline and the substitution by the Standard distillation Method of the American Society of Testing Materials for determination of the volatility of the motor fuel, the refiner has become more dependent on the use of natural gasoline to blend a specification motor fuel. The profit from the increase in value of heavy naphthas has helped a great deal during periods of low markets to keep the refinery going, and break even, and when better prices prevailed they were very material in producing a favorable balance sheet.

Blending to Continue

The advantage of blending with natural gasoline will become still greater if the Federal Specification Board will remove the end point specifications, leaving the 90 per cent over point as indicative for quality and limit for the inclusion of too many heavy hydrocarbons. It is easier to correct the 90 per cent over point by blending with natural gasoline than the end point and such a change would enable the refiner to increase the yield of gasoline distillate by including such heavier hydrocarbons, which by proper blending with natural gasoline could be made to meet intermediate and 90 per cent over boiling points, and produce a very desirable motor fuel. It is evident that in this case again natural gasoline will help in increasing the total amount of gasoline produced by refineries in the United States and thus meet the ever growing demand for motor fuel.

The steady decline of light crudes, rich in light gravity gasoline, would have been a serious handicap for the export trade, were it not for the increased supply and use of natural gasoline in blending for export specifications the distillates produced in our refineries from heavier crudes. As long as the export trade insists on high gravity gasoline, 64-66 and 60-60 gravity, it will not only take a large percentage of high-grade natural gasoline to blend for these grades, but even more so to make domestic motor fuel from the remaining naphtha after the lighter hydrocarbons have been taken out for export grades.

However, we must not neglect the fact that the foreign buyers and public are becoming aware that they are paying too much for these high gravity export grades; refining capacity in England and her colonies, is increasing continually, and more gasoline is produced annually by these refineries abroad. They will encounter and meet the same problems as we have in America and educate the motoring public to the use of lower gravity motor fuels. Already more 58-60 gasoline is imported into Europe each year in place of 60-62 or 64-66. Foreign engineers and chemists are working with all energy and diligence on "substitutes" for gasoline as suitable motor fuels. But even should the export market for gasoline fall off, the domestic demand for motor fuel will increase and in all probability offset such a decrease in foreign shipments.

Depreciation and Depletion for Gasoline Plants*

By A. B. Morris

Appraisal Engineer, Chestnut & Smith Corporation

FOR many people, the ideas embodied in the words depreciation and depletion are somewhat shrouded in mystery, due to some extent, no doubt, to the weighty sound of the words themselves, which has discouraged a closer examination into what they mean. There is another formidable word related to these two much as the surname of two brothers is related to the given name of each, and that is amortization. Strictly speaking amortization is the general term, and depreciation and depletion are specific kinds of amortization. Unfortunately for clearness, custom has attached certain specific meanings to the word amortization, so that for many its generic nature is lost, and it has come to be regarded as something basically different from the other two specifics.

A brief discussion of the relationship of these three words—amortization, depreciation and depletion—will help to a better understanding of this topic. When money is put into a profit seeking enterprise, it is generally impossible to recover anything like the amount expended except through two courses:

1. Sale of the venture to another operator, or
2. Operation of the property and recovery of cost out of operating profits.

In the first case we have a mere change of ownership, and the new owner then stands in the shoes of the original one and like him is under the necessity of recovering his capital outlay in either of the same two ways. Ultimately someone will have to resort to course No. 2 to recover the cost if it is to be recovered at all.

Operating Profit

Everyone knows what "Operating Profit" is. This term designates the margin between sales or other income from operation, and the cost, other than capital outlay, necessary to produce the income. If these profits are all paid out in dividends or otherwise withdrawn from the business and the time arrives when, for one reason or another, the abandonment of the venture becomes necessary, there will remain nothing out of which to pay back the investors except the junk value of the property. They will have put their money into the business and derived dividends therefrom which have eaten up their capital. They had a right to assume that the dividends represented true profits, whereas each payment included not only true profits, if any, but also a portion of their original investment. The company has lived upon its substance, and is in exactly the same position, economically, as a legatee who cuts into the principal of his estate for his current living expenses. The company has been thriftless.

In mercantile enterprises the value of the plant is small in proportion to the income expected and the total volume of business transacted and in addition is generally readily salvageable at nearly original cost; but in manufacturing and exploitation enterprises the plant cost is very large and the plant itself is of such a nature as to be salvageable only at a very large discount, regardless of its actual condition. In both mercantile and manufacturing enterprises the continuation of profits is very closely related to the individual efforts of those concerned; but in exploitation enterprises, the continuation of profits is primarily dependent upon the length of life of the resource being exploited. The natural gasoline industry is both a manufacturing and exploiting industry and is subject not alone to the laws of either one, but to the laws governing both classes of endeavor.

It is apparent then that from mercantile and manufacturing undertakings the return capital outlay may be spread over any reasonable period of time governed generally by the useful life of the equipment, since the assumption is warranted that the efforts of those concerned and hence the life of the business will be sustained beyond that period, indefinitely. Where the life of the business is limited by the supply of raw material, however, it becomes necessary to assure the complete return of capital prior to the exhaustion of the supply.

Amortization

Amortization, an accounting proc-

*Read before the Association of Natural Gasoline Manufacturers, May 5, 1926.

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The Liberty Tandemtype Cleaner with the rugged and simple Type "SF" Head, illustrated, is remarkable for sheer power and ability to remove the most stubborn deposits from oil still tubes. It also gives fast, enduring service with extremely low maintenance cost. It is the right tool for most pressure still service.

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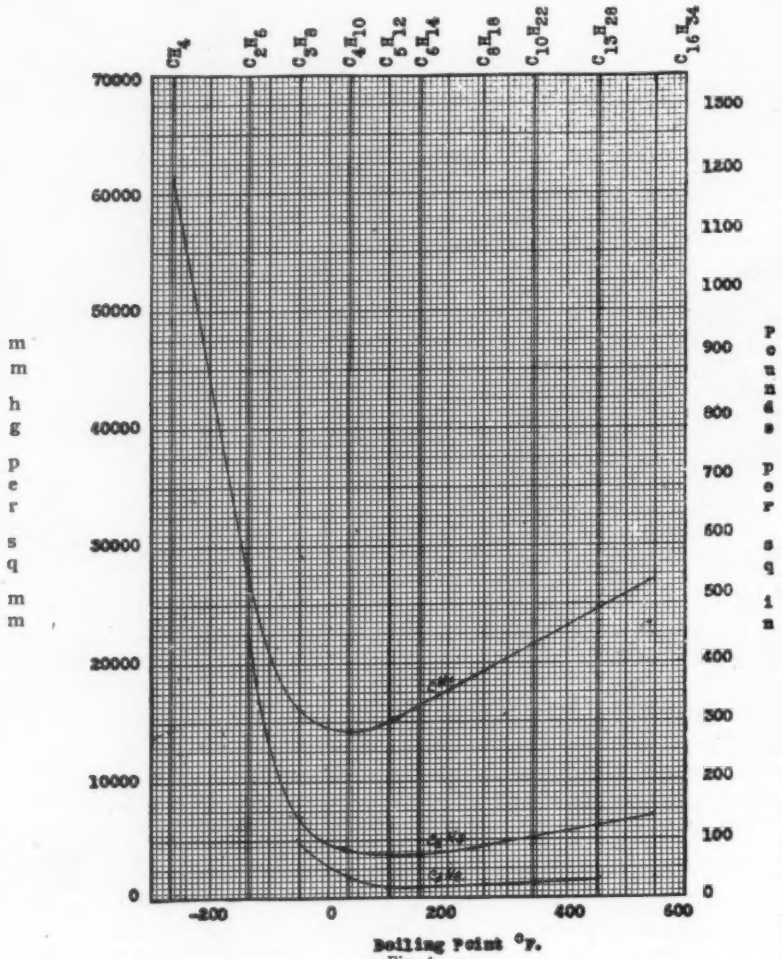


Fig. 1.
Vapor pressures of methane, ethane and propane in pure hydrocarbons. Research laboratory, Empire Refineries, Inc., Okmulgee, Okla.

ess, is the means by which this savings out of operating profits is accomplished. The portion of the amortization deductions held out of operating profits to return the cost of physical equipment is called depreciation; that portion which is held out to return the cost of securing the necessary supply of raw material is called depletion. If money has been borrowed to start the business and sinking fund payments are also deducted to retire, or amortize, this debt, such deductions are known as amortization, in this case used specifically. There are other specific meanings for amortization, which will not be touched upon here.

Strictly speaking these terms are accounting terms used in abbreviation of the more complete "deduction for depreciation" and "deduction for depletion." The actual depreciation takes place not on the books but in the physical property itself, through wear and tear, obsolescence, or market changes in equipment prices; and the actual depletion takes place in the supply of raw material as it is withdrawn for use, or depleted.

Bearing in mind the sole purpose of making these deductions from operating profits before computing true profits—these sinking fund payments to retire the original cost prior to the abandonment of the venture—let us consider the various ways in which this is actually accomplished in practice, by gasoline manufacturers.

Depreciation

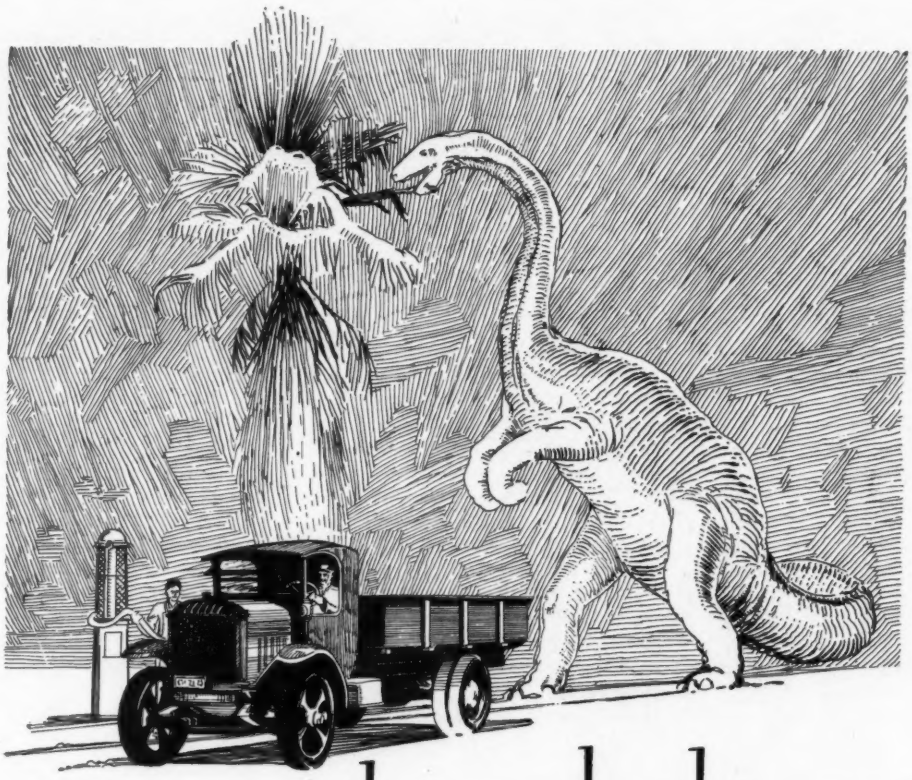
The simplest method and the one most generally in use is the so-called "straight line" method. This consists of adopting some percentage rate, chosen more or less arbitrarily and applying this to the investment figure each year, the product of the two being the amount to be deducted to provide for the retirement of capital cost of equipment. Thus if it is assumed that eight years is as long as the gas supply can safely be expected to last, 12½% of the original cost of equipment saved each year will retire the total at the end of that time. If the operations extend beyond that point, and the rate has been maintained at 12½% throughout, the point is reached at the end of the eighth year when these savings—this thrift pile, the depreciation reserve, as it is called—will equal the total investment, provided of course, that there have been no additions to plant in the meantime. Thereafter, it being unnecessary to save anything further from current earning on this account, deductions for depreciation cease, or become limited only to the return of the cost of subsequent additions. The plant is said to be "depreciated out." It may or may not have "paid out" long before. On the other hand, if the plant has to be abandoned at the end of the fourth year only half of the cost will have been returned and the balance remain as an almost valueless asset.

Rate Problematical

The ease with which such a depreciation reserve is handled, coupled with the fact that this method prevails generally in all other businesses, have led accountants generally to prefer it under nearly all conditions. In a business such as this, however, the choosing of the proper rate of depreciation is so highly problematical, so much open to question on theoretical grounds, and so likely to prove incorrect, once having been decided upon, that some operators are now turning toward another method of saving up their plant cost out of earnings, where the amount saved each year will bear a direct relation both to the volume of business done and the remaining supply of raw material upon the existence of which the continued operation of their plant depends.

This consists of making an estimate from all available data, of the ultimate production of the plant, that is, the total number of gallons of gasoline which is believed will be made before such time as operating profits shall cease to exist. Enough information can be had to make a reasonably accurate estimate of this kind for all except entirely new fields. Such an estimate should be computed by leases or other readily indentifyable groups, and after a year or two of operation, can be adjusted up or down as may be indicated by the additional data thus provided. The total of these estimates is then divided into the total investment account—or the total less an estimated salvage value not to exceed 20% —and the quotient, called the unit of depreciation, applied to each gallon of gasoline as it is produced. If depreciation is computed monthly, the monthly deductions can be computed on a continuous sheet or table, which will show any changes in the investment account and in the estimate of ultimate production. If the depreciation is computed only at the end of the year, the depreciation unit is applied to the full year's production.

The advantages in this method in my mind outweigh the objection of the additional labor of estimating and revising reserves. Besides affording a distribution over the entire life of the project of all plant cost, and assuring



Down through the ages . .

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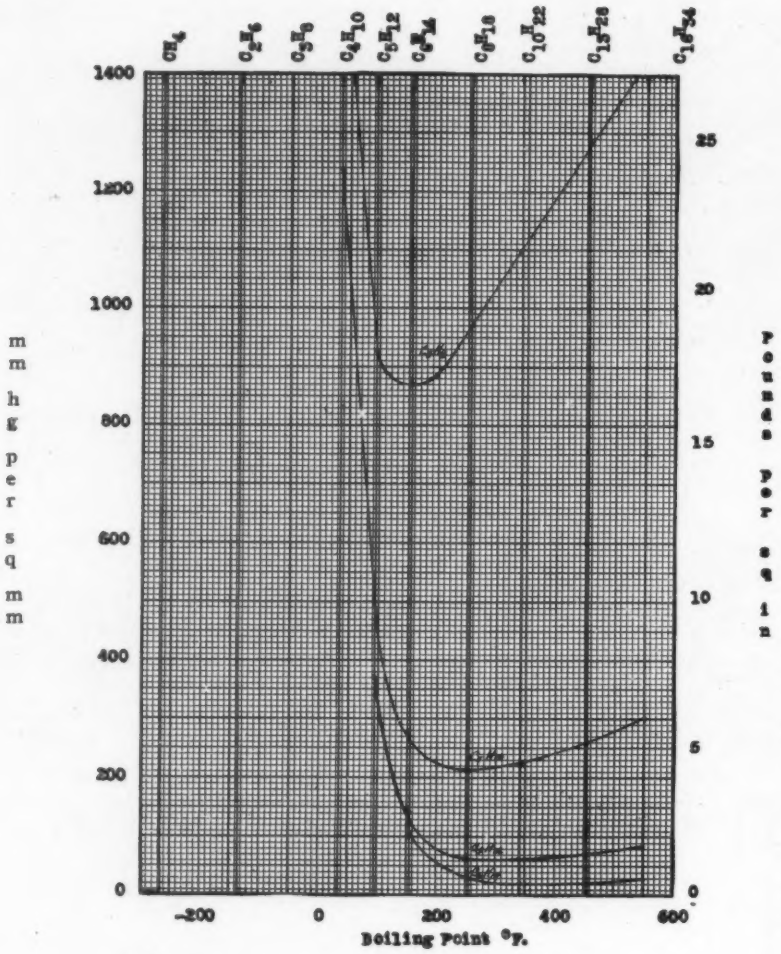

Fig. 2

Vapor pressures of butane, pentane and hexane in pure hydrocarbons. Research laboratory, Empire Refineries, Inc., Okmulgee, Okla.

the return of the full cost prior to abandonment, this method keeps the management at all times aware of the conditions of the gas supply, whether it is in danger of early dissipation, or adequate to maintain production at approximately present levels for a considerable period. The estimate of production will show at what rate new gas will have to be contracted for in order to maintain capacity operation; and indicates a considerable time in advance, when and where such efforts will have to be exerted.

For large concerns such estimates should be prepared entirely independently of their use for depreciation or depletion purposes. After they are once started, keeping them up to date requires but little labor. The small concern having but one or two plants, where no engineering staff is maintained, can have these made by outside engineers at relatively small cost, and can have them revised once each year, which would be often enough.

Salvage

Regardless of the method of computing depreciation, what items of plant cost should enter into the computation? What part of the original investment in plant is it necessary to save up to pay for? A finished plant consists of machinery, building material, pipe, masonry and labor. Labor includes ditching for pipe lines and all teaming costs and masonry includes concerte foundations and pits. When the gas supply is exhausted and it becomes necessary to abandon the plant what can be salvaged?

Machinery, pipe and building materials are all that have any value at all. The labor of erecting and installing is lost, and except for that part of it which went into concrete work, will very nearly have to be duplicated in order to dismantle the plant. Masonry is worthless. Second hand building materials have a value not much in excess of 20 per cent of cost of new; and machinery and pipe have a value largely dependent upon their condition and the state of the second hand market at the place and time of reclaim. The saving for depreciation must therefore cover the following items:

Not less than 60% of pipe cost.
Not less than 70% of machinery.
Not less than 80% of building materials.
Not less than 100% of masonry.
Not less than 170% of all labor and teaming.

Or if the plant were built on a contract, or purchased in operation, so that the above distribution could not be made, not less than 80 per cent of the entire cost of the plant. These ratios, when applied to the investment figures for five plants, closely approximate 80 per cent of the total cost of the plants. However, I have seen no actual figures to support this 20 per cent net salvage value.

One Company's Way

An interesting example of the handling of depreciation is the following related by a member of this association. The company had three plants in the same pool. They use the unit basis for computing depreciation, and accordingly estimated the gas reserves in each of the several leases connected to the plants. It became advisable to abandon plant No. 1. Some of the gas formerly going into this plant was turned into each of the other two plants, No. 2 and No. 3. Plant No. 1 investment was credited with depreciation already written off and with material salvaged at condition prices, which followed the items to their new locations and was charged with the cost of dismantling. The balance was divided between Plants No. 2 and No. 3 in the same proportion as the estimates of gas formerly going to Plant No. 1 but now turned into each of the other plants. Thus if the estimate of gas reserves were 500,000,000 M. cubic feet and Plant No. 2 took over leases representing 300,000,000 M. cubic feet, Plant No. 3 taking the balance, the balance of Plant No. 1 investment after making the credits noted above was split, 3/5 of it being charged to Plant No. 2 and 2/5 to Plant No. 3. Thus, both the gas reserves and the investment at each of these plants were increased. It may be objected that this method unduly penalizes the surviving plants; but this appears to me to be rather short sighted. The company did go into that field and did make certain investments in plants to get the gasoline out of the leases contracted for. It appeared convenient to construct their plant in three large units, one of which later could be done away with. There is no less reason for insisting upon the separate handling of depreciation on the several compressor units at any one plant.

Depletion

The oil industry was made familiar with this term through the operation of the income tax. As applied to producing oil properties there is little misunderstanding of it. It is simply the means whereby return of cost (or value) of oil in the ground is secured

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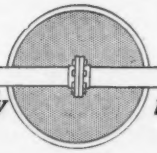
The strength of the line is only  *the strength of the Flanges*

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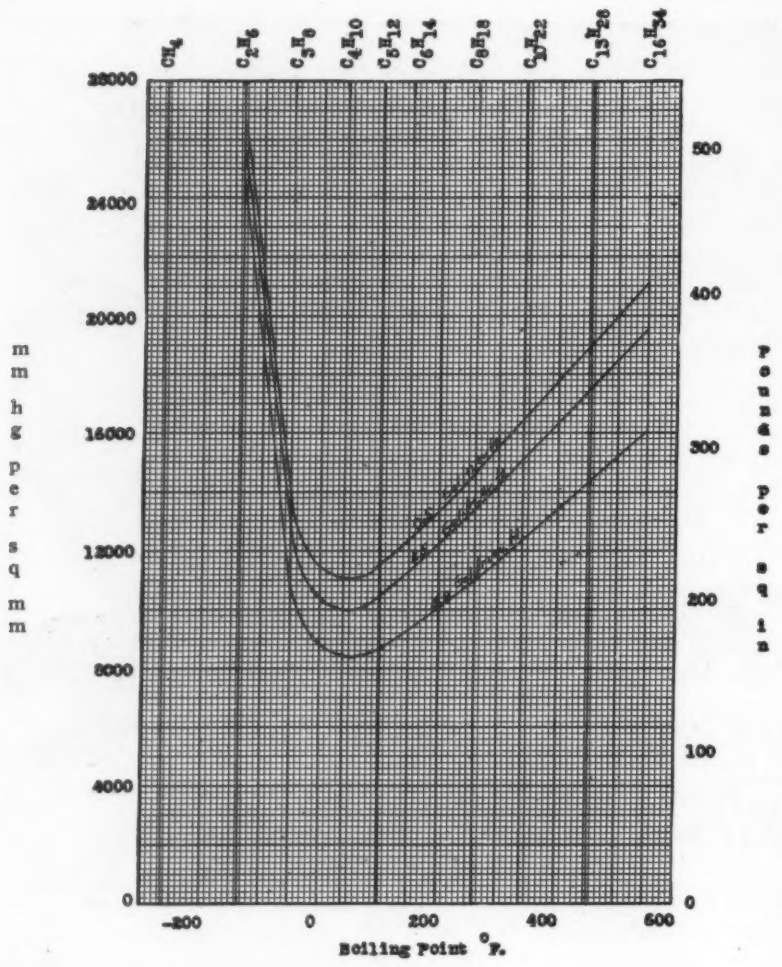

Fig. 3
Vapor pressures of natural gases in pure hydrocarbons, concentration 10 per cent. Research laboratory, Empire Refineries, Inc., Okmulgee, Okla.

free from tax as income, because it is not income at all but return of capital. Gasoline manufacturers gained some benefit from depletion of the value of their "gas contracts" paid in for stock or acquired as a gift of the stockholders; and in some few instances depletion on actual cash cost of gas supply came to light. Changes in the income tax law have robbed the tax angle of the subject of its general interest; so instead of considering depletion in its relation to tax matters I will discuss its uses for general accounting and operating purposes.

It frequently happens that a plant is purchased after having been in operation for a considerable period, and all the gas purchase contracts are assigned to the purchaser. The total consideration is often much in excess of the cost to replace the plant with one of like kind and condition; so that deductions for depreciation as defined above would be inadequate to retire the total cost. The excess, or bonus cost of the plant and contracts, is properly chargeable all to contracts, and the retirement of this cost is called depletion. The savings made on this account are to provide for the return of cost of gas supply that is being depleted in the same manner that savings on account of physical equipment are to provide for the return of cost of equipment which will be of small value when the venture is abandoned.

In practice there is seldom any distinction made between depletion of this kind and depreciation. That is, the bonus cost if any, is retired through one account along with the value of the physical equipment. There is no serious objection to handling return of cost in this way; but some advantages develop from keeping the two separate and distinct.

For example, I have found in appraising many plant properties, both for tax purposes and for economic purposes, within the government service and outside it, that where a unit capital cost of gasoline in the ground, much in excess of 1/10 of the market price of gasoline at the loading rack is used, true profits tend to disappear, or are at best very uncertain. Thus for a gasoline market ranging between 10 cents and 15 cents per gallon, the maximum cost for reserves consistent with profitable operation is about 1¼ cents per gallon. If physical value and bonus cost are lumped together in computing deductions to provide for return of cost, there is no way in which to tell whether or not the amount paid for gasoline in the well exceeds this limit or not. With the two carried separately, and an estimated gallonage reserve set up for computing the true deductions for depletion, it is at once apparent whether or not these limits are being exceeded; and if they are, efforts can be directed to securing additional gas contracts until the increased reserves of gasoline result in a sufficient reduction of the unit cost per gallon. If such an estimate is made prior to the purchase, many a costly mistake can be avoided.

Earning Power

This brings us to relation of amortization reserves to earning power and value of the project as a profit making enterprise. The cost per gallon of production for depreciation or other amortization charges as shown in the operating statements of any plant has no bearing on the value of the plant to a prospective purchaser, and should be eliminated from all computations of such value. This does not mean, by any means, that the item of amortization should be neglected in arriving at a proper purchase price. On the contrary, unless return of capital is taken into account in settling a bid price for a plant, a price far in excess of the actual value as based on earning power will be paid without proper compensation. It may be necessary for tactical or strategic reasons, to pay an excessive price for some one particular property, but the buyer should at least be in the position of knowing what his plant is worth per se, and how much he is paying for the tactical advantage sought.

There are two ways in which the value of a plant based on earning power can be determined, one which can be called the "present worth" method; and the other which can be called the "pay out statement" method. Both these depend primarily upon an estimate of the future annual production of the plant, and will be accurate only to the extent that such estimate is accurate. It is possible to estimate the next year's production within very narrow limits; the second year's production is subject to wider error, and thereafter the estimate for each succeeding year is liable to be more and more inaccurate. Hence that method of valuation which requires the fewest number of estimates of annual production will yield results which will correspond most closely to actual performance. For this reason I prefer the pay out statement method of plant valuation to the present worth method, since in it the estimates for only the succeeding three or four years are in-

cluded, whereas in the present worth method annual estimates clear down to the probable date of abandonment become necessary. Moreover, in the pay-out statement method, return of capital is automatically provided for, but in the present worth method it is a very involved function of the projected purchase price.

The effect of amortization of capital cost—whether depreciation or depletion—upon the value of an operating gasoline plant will be seen from the following exposition of the two methods of computing value.

Present Worth Method

After preparing the estimate of future annual production of the plant a selling price per gallon must be chosen which it is believed will be safely within the average for the remainder of plant life. From this average future selling price and the estimated annual production, the estimated annual gross sales are computed. Plant operating costs by years can be estimated either by taking the present cost per gallon as a unit, or by estimating the cost for each year in a lump. The estimated gross profits for operation in each year are the differences between these two figures. The sum of these differences for the estimated number of years of plant operation is the total gross operating profit of the plant. But these profits are received, not in a lump sum immediately, but in annual installments spread over a period of years. They are therefore not now worth par. A compound discount factor of 10 per cent for the present worth of these annual installmetns is generally used. Each installment is therefore discounted by its proper factor, and the sum of these products is the present worth at 10 per cent of the gross operating profits. But these figures do not include depreciation or depletion. For simplicity, this is generally provided for by deducting from the last sum above mentioned, the appraisal value of the plant equipment or reproduction cost new less actual physical depreciation, leaving a balance which is said to be the value of the earnings of the plant. In reality I believe that this figure is a combination of the value of the net earnings plus the bonus value of the gasoline in the ground, since annual earnings of only 10 per cent on cost are not sufficient to induce capital to flow into this business. If a higher discount rate than 10 per cent is used, say 15 per cent or 20 per cent or some rate which may be considered adequate and attract capital, the present worth value of the gross profits shrinks so rapidly that they soon equal the appraisal value of the plant, at which point all bonus value disappears. Due to the operation of the compound d scount all the factors of such a valuation are so involved as to have their relation, each to each, obscured, and the relatively large number of years which have to be included in the esti-

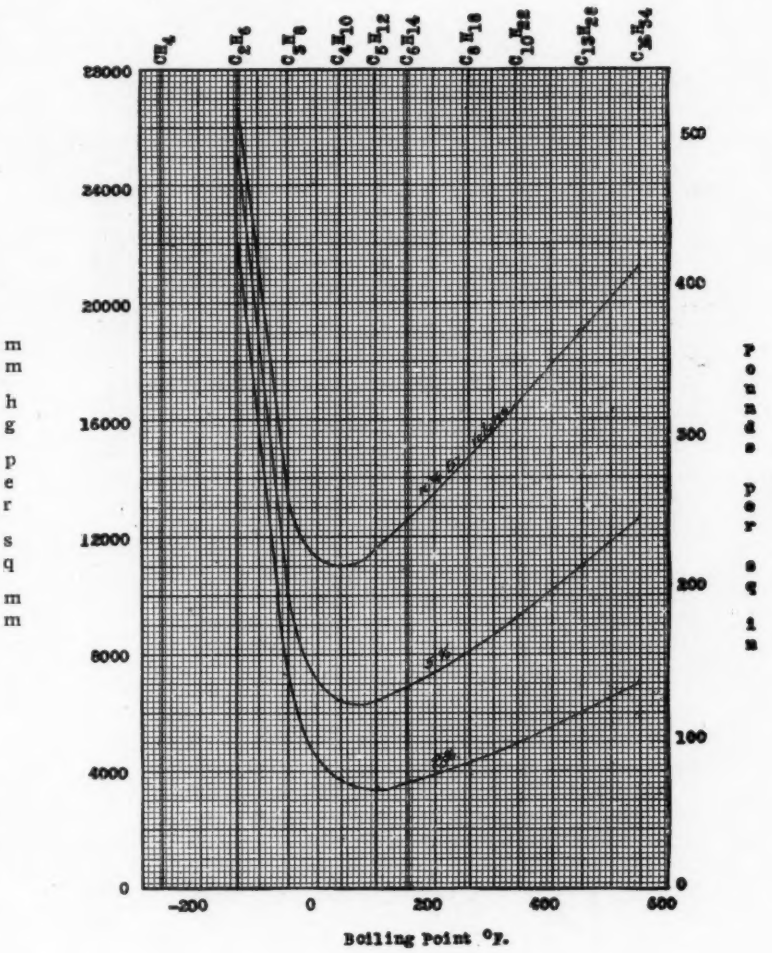

Fig. 4

Vapor pressures of natural gas in pure hydrocarbons, three concentrations. Research laboratory, Empire Refineries, Inc., Okmulgee, Okla.

mates of both annual production and future average selling price tend to rob the appraisal of its value. A further objection is the necessity which exists of choosing a discount rate, which must be done altogether arbitrarily. This makes the entire computation subject to the accuracy of still another guess. Such an appraisal is still further open to attack upon technical grounds, as the manner of using compound discount, and varying opinions are held by experts yielding quite different results from the same basic figures.

Method Simple

This method of plant appraisal does not concern itself at all with present worth or money rates of earning which may be called satisfactory. It seeks only to determine the total actual amount of gross operating profits necessary to return a given capital outlay within a given period of time. If all or most of the gas contracts under which a gas supply for the plant is obtained expire or are cancellable on short notice after, say the middle of the second year hence, no one would think of investing in the plant a sum greater than could be recovered from gross operating profits within the next three years at the outside. It is therefore necessary only to use the estimated annual production for the next three years in determining the amount of these gross profits, and this figure can be approximated much more closely than an estimate involving the next seven or eight years. Also a guess at the future average selling price for the next three years is much more valid than one covering the longer period and it is not necessary to assume a satisfactory rate of earning before proceeding with the appraisal. The operating statement of the plant is then resorted to. The cost per gallon for gas is divided by the average selling price per gallon over the same period, and the chosen future average selling price per gallon is multiplied by this ratio to determine what will be the cost of gas at that plant with gasoline selling at the chosen price. From the total cost per gallon on the operating

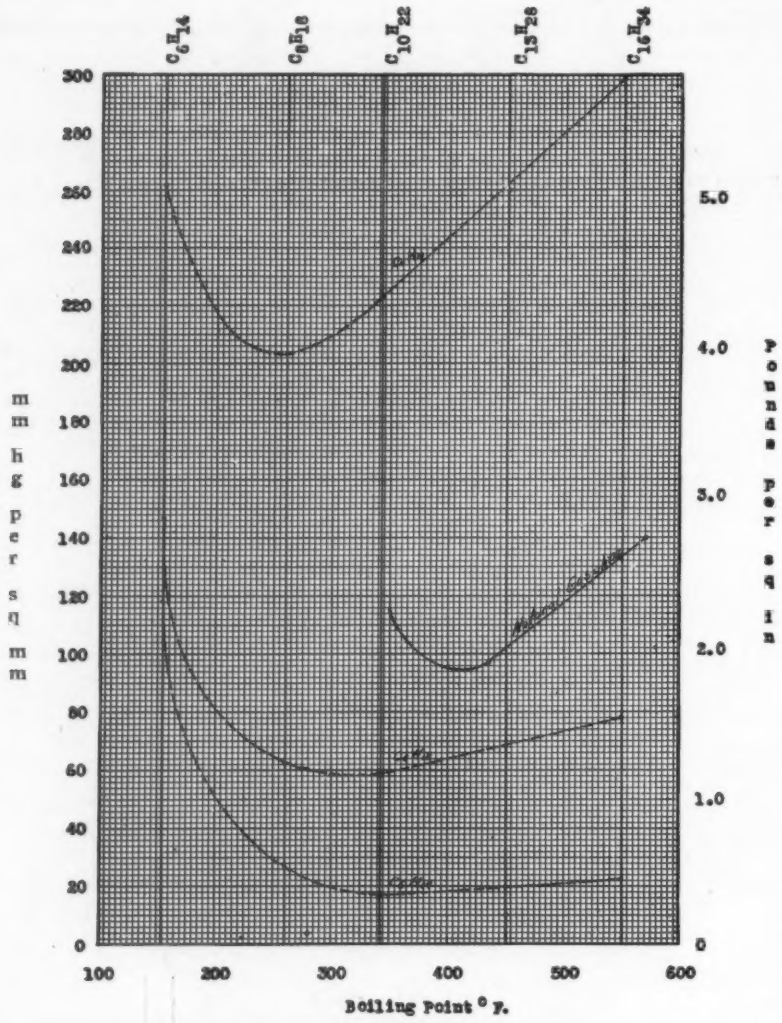

Fig. 5
Vapor pressures of natural gasoline-naphtha blends.
Research laboratory, Empire Refineries, Inc., Okmulgee, Okla.

statement are deducted the following units:

Cost of gas per gallon of gasoline
Cost of depreciation per gallon of gasoline
Cost of overhead per gallon of gasoline

leaving a balance which is actual plant operating cost per gallon. To this is added back the new gas cost arrived at as above described, and the purchaser's gallonage overhead charge, but no depreciation, since the depreciation (or total amortization of capital cost) is dependent solely upon the price paid, which is the figure we are seeking. The total of these costs is then the estimated manufacturing cost of gasoline under the market conditions chosen. Deducting this from the chosen future average selling price, there is left a future average gross profit per gallon. This multiplied by the estimated annual production for the next three years gives the estimated gross profits from operation at the end of three years. This then is the most that can reasonably be paid for the plant, and if it exceeds the physical appraisal, the excess is cost of gasoline in the ground. The value thus derived is the value for this plant to "pay out" in three years, provided that market conditions approximate the estimated selling price. If the project must then be abandaned through inability to renew contracts, the buyer will at least have received his money back and will still have the salvage in the plant for his profit. If the project can be continued, all gross profits after the third year will be true profits and will represent the purchaser's return on his investment.

By whichever method value is computed, the values arrived at are much lower than are supposed or alleged by many to prevail. If some method of plant appraisal which took into consideration the operation of fixed charges were resorted to by everyone contemplating the construction or purchase of a plant, there would be far fewer dazzled by the size of the gross operating revenue, and there would be far fewer disasters in the industry, the cost of which falls on the survivors and on the public. Gasoline production can never properly be quoted at a flat rate per gallon. Instead its value is inseparably connected to the life of the gas supply and to the conditions of the gas purchase contracts. Also capital charges, such as depreciation and depletion are direct functions of the purchase price paid for the property and have no definite or universally applicable value either as to amount or rate. Under present market conditions, or under any that can reasonably be expected to prevail over the next three or four years period, values approaching $100.00 per gallon of current daily production could rarely be paid without far exceeding the 10 per cent selling price limitation for bonus cost of gasoline in the well.

England Buys More Crude and Less Gasoline in 1925

Washington, D. C.—The steadily increasing growth of the British refining industry is strikingly shown in a study of the British petroleum trade in 1925, made public today by the Commerce Department. As a result of this development of the domestic industry, the report points out, the character of the import trade is changing. The British are beginning to increase their foreign purchases of crude petroleum at the same time lessening those of refined products.

This trend which probably is destined to grow in direct ratio to the development of the domestic refining industry is one of considerable interest to American exporters in view of the fact that Great Britain has long been our largest individual market for refined petroleum.

Great Britain, the report reveals, obtains almost half of its crude petroleum from the Persian fields with Curacao and Mexico supplying a considerable portion of the remainder. Imports of crude petroleum from the United States are insignificant. However, while this country plays but a minor role in the crude petroleum trade of Great Britain, a study of the figures for imports of refined products discloses the dominance of the United States in this field. Last year 47 per cent of the gasoline, 58 per cent of the kerosene, 80 per cent of the gas oil, 24 per cent of the fuel oil, and 85 per cent of the lubricants imported into Great Britain came from the United States. With the exception of fuel oil, every one of these individual items shows a decline as compared with 1924.

While there is practically no production of crude petroleum in Great Britain, there has been considerable development of the shale oil industry in Scotland.

The complete report, entitled British Petroleum Trade in 1925, based on reports of American consuls and the American Commercial Attache in England, was prepared in the Minerals Section and is published as Trade Information Bulletin No. 407. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., or any district office of the Bureau of Foreign and Domestic Commerce. The price is 10 cents.

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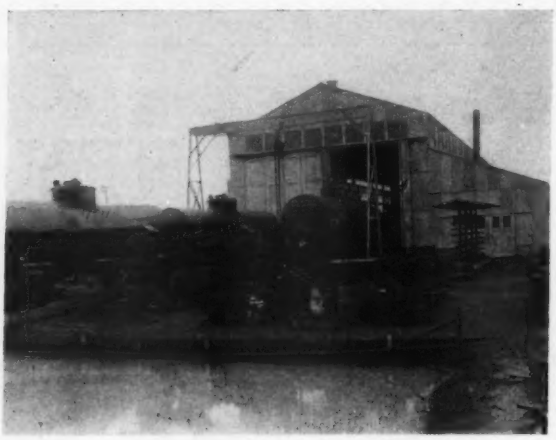


Material platform at the east side of the shop

Pure Oil Builds Modern Car Shops At Heath, Ohio

By E. A. Kraft
In the Pure Oil News

BEFORE proceeding with the description of the shop, it is thought that some comment on the tank car and the rules with respect to its upkeep will be of interest to readers, who will then better realize the need of just such a shop as has been provided.

The tank car is designed for the transportation of liquids or gases. Like all other freight equipment it must meet the standards of the Interstate Commerce Commission relative to safety, the regulations of the American Railway Association regarding strength of body and truck parts, must be equipped to transport the particular kind of liquid for which it has been designed, and before acceptance in interchange, must be in good condition and not leaking, and not in danger of leaking while in transit.

Service Requirements

In addition to meeting all the requirements for the conventional type of freight car, the tank car must conform to regulations of the Bureau of Explosives. These require that the tanks be made of a certain quality of steel, riveted (or welded) in accordance with special rules, have dome of certain sizes, safety valves where necessary, unloading valves of certain types and all fittings or connections according to their design. The owner of car is responsible for adherence to these rules which have power of law. Known violations are subject to fine and imprisonment. In addition the tank and safety valves must be tested at certain intervals otherwise cars must be withdrawn from service.

Comparison With Other Freight Cars

So long as railroads exist accidents will happen, through failures of equipment, trackage, human carelessness or other causes. When such accidents occur involving loads of coal, lumber, or other commodities there is always a considerable loss of property with danger of loss of human life, but when there is added to this, the danger of a leaking tank car, containing an inflammable and explosive liquid which when released flows over the wreckage and surrounding area there is a tremendous hazard not only to the property involved but to the general public. Confronted with this danger the Bureau of Explosives expects tank cars to be absolutely tight containers with strength to withstand such shocks and derailment without any leakage.

Higher Standard of Maintenance

In order to overcime one of the possible causes of accidents, namely failure of equipment, naturally the tank car is the subject of closer inspection than other freight cars. Defects which might not be considered serious in a gondola or box car are not permitted to continue in a tank car. The responsible tank car owner, who may also be the shipper of an inflammable liquid, is inclined to encourage this close inspection, detecting minor defects before they become major. This attitude in the interest of safety tends to develop a higher standard of maintenance.

Repairs Necessary

It is obvious that once a car is delivered to a carrier, control of its physical condition is lost until the car is again offered at one of our plants. Ordinary failures which require attention en route are repaired by carriers, the cost of such work being charged owner according to an established code of rules and scale of prices. Defects of lesser importance are permitted to remain until the car is returned to the owner. Likewise failures of parts peculiar to tank cars, and for which the required replacement parts are not carried in stock by carriers are not corrected until the cars are returned to the owner for attention.

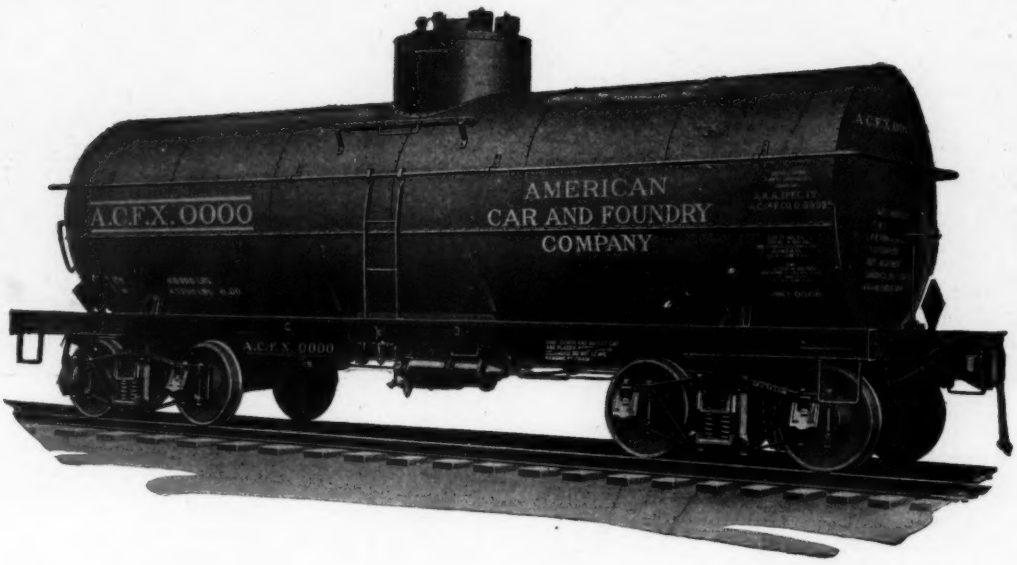
Upholding Standards

The American Railway Association rules for interchange of freight cars endeavor to define conditions under which failures occur, making handling line responsible under certain circumstances. They also provide for maintaining owners' standards. Our inspectors, therefore, in addition to knowing that the cars are safe and serviceable, see that repairs when made by carriers are proper, or obtain their authority for necessary correction; and when parts have been damaged, insist on proper acknowledgment and authorization for repairs before acceptance. The practical application of American Railway Association rules always permit the use of inspector's judgment and having well trained men at this work insures protection and materially reduces the cost of upkeep.

Vital Points

Tank—When loaded, the tank must not permit even a dropping of liquid at a rivet or at seam. The tank must have been tested with cold water pressure of 60 pounds or 75 pounds per square inch within prescribed limits. The safety valves must be tested at certain intervals. Outlet valves must be carefully ground and free of rust or scale, and when cars are equipped with heating coils, they must be in good order.

Trucks—Wheels and axles must not



Good Tank Car Workmanship Helps You Pay Dividends

The "Car Foundry" method of building tanks is especially desirable for Class IV Cars. First, all rivet holes are reamed accurately to size. This work is done by special machines which have been developed to overcome the unavoidable inaccuracies of hand reaming. Next, the tank rivets are machine driven, including the cylindrical as well as longitudinal seams. This insures mechanical accuracy which cannot be obtained in hand riveting. Special machinery for the purpose has been developed. Finally, the rivets are heated electrically to insure uniformity.

Unusual care is then given to the application of insulation. In this respect, as in others, the aim is to exceed the standard specifications. "Car Foundry" workmen take pride in making a perfect job of it, and their efforts are reflected later in minimum outage losses, dependable service, low cost of maintenance, and durability.

"Car Foundry" insulated tank cars not only fully comply with A. R. A. and I. C. C. requirements but also embody many valuable and exclusive special features.

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Mention Where You Saw the Advertisement

Main shop

Airbrake room

show more than certain wear, oil boxes properly packed with oil and waste prepared to a standard; all truck parts must have proper clearance from rail, and all bars and bolts must be tight. The slightest trace of a crack in an arch bar, will cause rejection of car.

Car Body—Sills must be straight, all rivets tight, connection to tank secure, proper clearance between body and truck side bearings, couplers at standard height, and draft gear in proper adjustment. This draft gear, which is the shock absorber of a car, is of the greatest importance and is most frequently neglected by carriers. When considering that this part takes up the shock of blows of nearly a million pounds, it will be appreciated that lack of attention indefinitely would permit these strains to pass through the car body with consequent failures.

Correcting Weaknesses

When in any series of cars failures of certain parts become numerous, the conditions entering into their service are thoroughly investigated. It has been found necessary to have designed for us special castings or other parts which have helped to materially over-overcome defects of a recurrent type. While original parts were according to accepted standards, improvements thus made have added materially to their strength with very little additional cost.

Varieties of Cars

As may be expected, the equipment has various standards to accord with capacities which range from 3500 to 12,500 gallons. We operate cars built by practically every tank car builder and each of these types has parts peculiar to themselves. Also, as the age of the cars varies, and betterments have been made, such changes do not always permit interchanging of parts and it is necessary to maintain a large variety of castings to properly repair cars. Of course, much of the ordinary freight car body has been standardized.

Need of Repair Shop

In 1919, realizing the need of a repair shop, plans were made for a complete shop at London, Ohio. While this plan did not mature, a temporary car shop was authorized in 1920. This was placed at the Heath Refinery. At that time a building sufficient to house three cars, together with a small blacksmith shop and stockroom was constructed. As our equipment increased, some additions were made, both to the trackage and material storage, which relieved us to some extent, but when it is considered that our equipment increased over 150 per cent during the period that this temporary shop was in operation, it will be apparent that we were working under a handicap. The necessity of doing a great portion of the repair work in the open, made the volume thereof dependent on weather conditions. It will be of interest to know that during the time this temporary shop was in operation, practically no work was sent to outside shops, excepting cars which when damaged, located at points distant from Heath or in a few cases where the entire tanks had to be cut down. This temporary shop on April 6, 1925, was practically destroyed by fire. This, of course, did not stop our operations as we continued repairing cars with interruption of only a few hours work but our output was restricted on account of lack of tools and supplies, which were replenished as promptly as was possible. When the matter of rebuilding the shop was placed before our executives, due consideration was given to the increase in the tank car equipment, the stricter and ever changing requirements of the Bureau of Explosives, the Interstate Commerce Com-

Store room

Office

mission and the American Railway Association, and to the difficulty of economical operation with previous handicaps. The shop then authorized we now wish to describe.

Trackage

The original shop covered only a single track, but when the building was replaced another track was added. These tracks are connected outside the shop with a cross-over arrangement to permit the ready shifting of cars from one track to the other. In all we have approximately 1400 feet of track available for repair work.

Main Building

This has been designed according to latest practice for buildings of this type. It is 60 feet in width and is 150 feet in length. The total width is divided into a main shop 40 feet wide while the other 20 feet is used for blacksmith, locker, air brake and store rooms. The construction is of steel and glass, the framework is of sufficient strength to permit the use of a ten ton traveling crane and is of a height to permit 21 feet clearance beneath the crane. The steel used in the building is of a panel type of galvanized copper steel while every opportunity for lighting has been taken advantage of, even to the use of skylights in the roof. This has made it a thoroughly "daylight shop." Each end of the shop is equipped with double folding doors providing ample clearance for moving cars in and out. The crane is of a ten ton forty foot span Mahr type which permits the raising and handling of tanks to any part of the shop. This building will accommodate six cars for heavy repairs, permitting removal of trucks from under either end while cars are jacked up. During severe weather when heavy repairs on trucks are not required, we can place eight cars under cover for painting, etc.

Lean-to Portion

This part of the shop has also been designed with a maximum of lighting and ample head room has been provided for thorough ventilation. It is divided into four separate sections as follows: A blacksmith shop 20 x 45 feet, which is only separated from the main shop by a safety wire screen. A locker room 20 x 30 feet, and air brake room 20 x 30 feet and a stock room 20 x 45 feet.

Blacksmith Shop—This contains our forge, anvil, face plate, other blacksmith tools, drill press, grinders, pipe vises, etc.

Locker Room — Individual lockers have been provided for the workmen, showers and lavatories and the like and provision made for eating their lunches in comfort.

Airbrake Room—The air compressor has been placed in this room, where it can be constantly attended to by our air brake repair man. This room contains our triple valve test rack, safety valve tester, and other miscellaneous testing devices, as required by governing bodies. All repairs to small tools and the like are taken care of in this part of the shop.

Storeroom—This has been placed at the end of the shop and is fitted with double doors adjacent to a roadway for convenience in handling material. The interior has been fitted with sufficient adjustable steel shelving to handle the small parts usually carried in bins and the remainder of the room has been devoted to storage of other car parts and accessories. Of course car couplers and extremely large castings which are not affected by the weather are carried on open material platforms.

Office Building

To avoid the noise and confusion in the main shop building, there has been erected a separate office building. It is located 100 feet from the shop, is of brick and tile construction with tile roof.

Bolene Adding Jenkins Units at Enid Refinery

Tulsa, Oklahoma.—Operation of the two Jenkins cracking units now under construction at the Bolene Refining Company's plant at Enid, Oklahoma, will start about June 15.

The Bolene Company recently leased the Oil State Refining Company refinery at Enid and will operate it on surplus crude available to its other plant.

RECENT REFINERY PATENTS

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the refining industry were granted by the United States Patent Office during April:

No. 1,579,326, granted April 6 to Harold L. Kauffman, Parco, Wyo., assignor to Producers and Refiners Corporation of Wyoming, for a purifying and de-colorizing agent for oils having as its base leverrierite, a mineral.

No. 1,579,515, granted April 6 to Dick Kendall Cason, Jr., Nacogdoches, Texas, for an electrical dehydrator for crude oil, comprising a series of conical shaped plates, alternate ones of which are grounded and the intervening plates being electrically insulated and connected to a high tension circuit, said plates being spaced apart by gradually increasing distances from top to bottom of said dehydrator, and having openings therein in the manner described.

No. 1,579,554, granted April 6 to William M. McComb, New York, for an apparatus for converting higher boiling point hydrocarbon oils into lower boiling point hydrocarbon oils, comprising, in combination, a tubular continuous spiral coil arranged with its axis vertical for converting hydrocarbon material, the lower turns of the said coil having increased inclination to accelerate the passing material, and a plurality of electric heating units operatively associated therewith.

No. 1,579,601, granted April 6 to Gustav Egloff, Chicago, Ill., for a process of converting relatively high boiling point hydrocarbons into lower boiling point hydrocarbons, consisting in externally heating a bulk supply of oil and in simultaneously producing an electric arc within the body of said bulk supply of oil to heat the oil to a cracking temperature, in passing the evolved vapors through an aerial condenser from which reflux condensate returns to the bulk supply of oil, thence to a condenser and a receiver and in maintaining said bulk supply of oil under a self-generated superatmosphere vapor prsesure.

No. 1,579,607, granted April 6 to Ralph A. Halloran, Berkeley; William N. Davis, Oakland, and George A. Davidson, San Francisco, Calif., assignors to Standard Oil Co., San Francisco, for the treatment of dirty acid derived in the acid treatment of petroleum oils, which consists in subjecting such dirty acid in a closed retort to a pressure of over 50 pounds gage per square inch, while raising the same to the high hydrolyzing temperature, thereby separating the same into relatively weak clear acid and a tarry residue, and withdrawing these products separately; and for the process of treating dirty weak acid derived in the treatment of petroleum oils with sulfuric acid, which consists in subjecting the same, intermingled with fuel oil in a relatively small quantity, in a closed retort wherein a pressure of over 50 pounds gage per square inch is maintained, to a high hydrolyzing temperature, whereby the mass is separated into a relatively weak clean acid and a liquid fuel, and separately withdrawing said products.

No. 1,579,799, granted April 6 to Russell Wiles, Riverside, Ill., assignor to Standard Oil Co., Whiting, Ind., for a process of refining oils for the production of gasoline which comprises subjecting hydrocarbon gases containing gasoline constituents to the absorbent action of reduced crude oil, admixing the reduced crude oil with crude oil containing gasoline and heavier constituents and fractionally distilling the mixture.

No. 1,579,801, granted April 6, to Joseph E. Babb, Pittsburgh, Pa., as-

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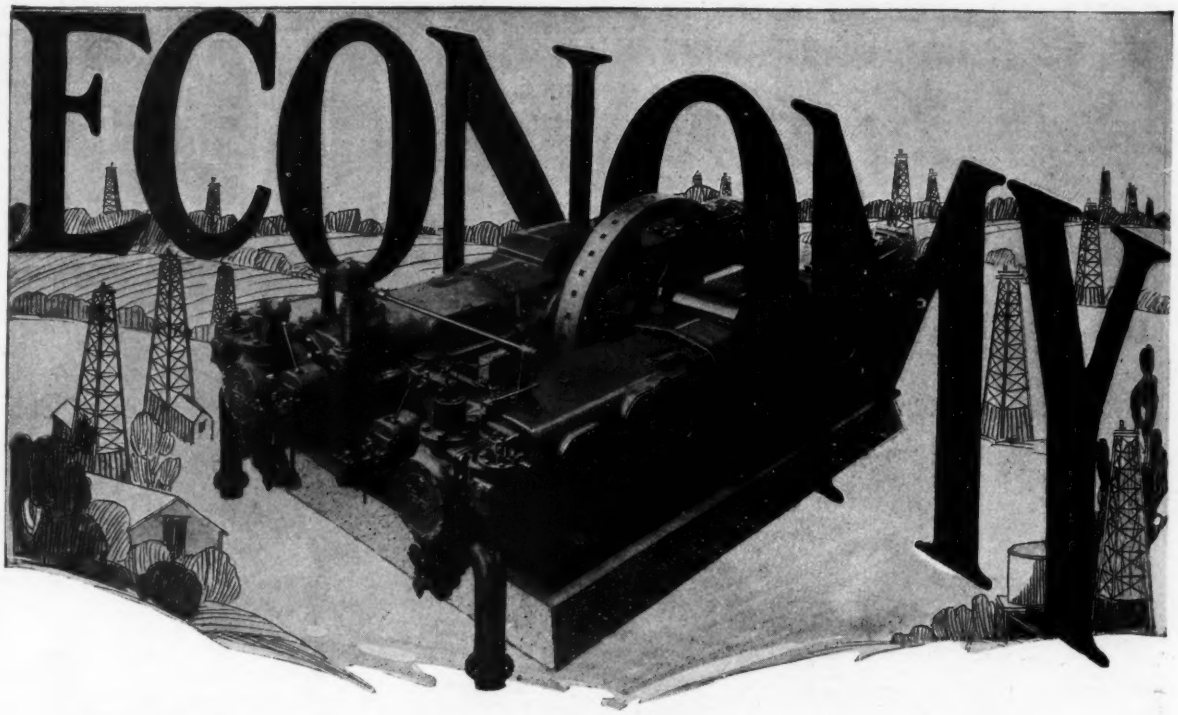

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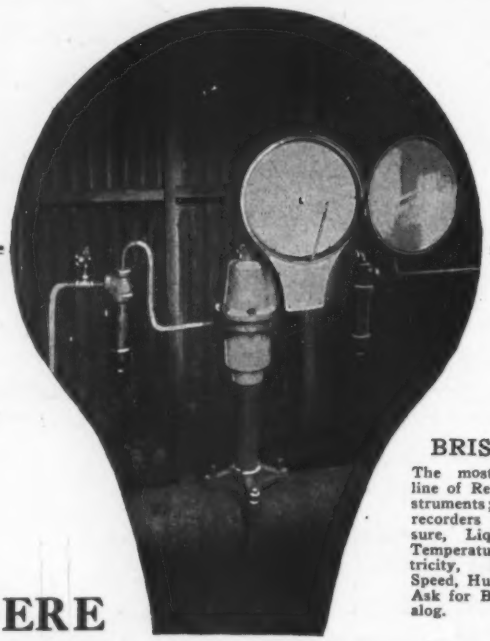

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signor to Waverly Oil Works Co., Pittsburgh, for a fuel composition comprising an explosion motor fuel and a gum of resinous character that is soluble in gasoline, combined with a lead oxide.

No. 1,579,802, granted April 6 to Joseph E. Babb, Pittsburgh, Pa., assignor to Waverly Oil Works Co., Pittsburgh, for a fuel composition composed of a distillation product of rosin and oxide of lead, the acids of the rosin being in excess of the quantity thereof which the amount of contained lead is capable of neutralizing.

No. 1,579,803, granted April 6 to Joseph E. Babb, Pittsburgh, Pa., assignor to Waverly Oil Works Co., Pittsburgh, for a fuel mixture for internal combustion engines, comprising, in combination with a lead oxide, of an organic acid compound in quantity sufficent to chemically unite with the lead present after combustion, for rendering substantially all of the lead volatile or gaseous.

No. 1,580,194, granted April 13 to Clifton A. Glass, Kansas City, Mo., for an oil tank comprising rigid side walls and a closed top, a horizontal curtain within the tank having its periphery spaced from the wall of the tank to permit the curtain to float freely within the tank, the curtain having a flexible side wall sealed at its upper edge to the upper portion of the tank wall to separate the part of the tank above the curtain from the part of the tank below the curtain, irrespective of the height of liquid within the lower part of the tank, the roof having a vent affording open communication between the upper part of the tank and the atmosphere.

No. 1,580,372, granted April 13 to Norton F. W. Hazeldine, Los Angeles, Calif., for an oil distilling apparatus comprising a tank and a substantially horizontal partition dividing the tank into vertically adjacent chambers, an inner shell within the upper chamber and spaced apart from the walls thereof to provide a jacket for cooling fluid, an opening in the partition, a riser extending upwardly from said opening and projecting through and above the bottom wall of said inner shell, and means for withdrawing liquid from said shell at a point beneath the outlet opening of the riser.

No. 1,580,531, granted April 13 to James B. Rather, Brooklyn, N. Y., assignor to Standard Oil Company, New York, for a process of treating petroleum oils, which includes, dissolving hydrogen sulphide gas in the oil, and combining the oil containing said dissolved gas with a mixture of sodium hydroxide and litharge (or sodium plumbite) to produce lead sulphide suspended in the oil, the lead sulphide serving to promote reaction between sulphurous elements in the oil and the plumbite solution in such manner that

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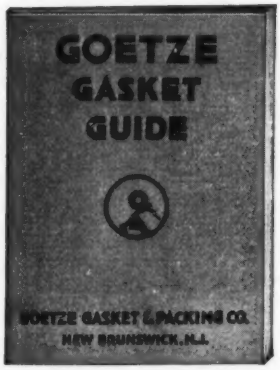

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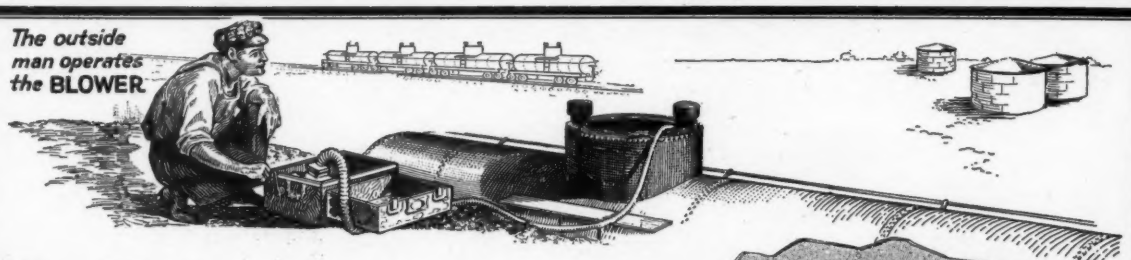

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the oil so treated is sweet to the "doctor" and non-corrosive in character.

No. 1,580,591, granted April 13 to Harold C. Eddy, Los Angeles, Calif., assignor to Petroleum Rectifying Co., of Calif., for a process of separating water and solid impurities from an oil emulsion which comprises: treating the emulsion to agglomerate the fine water particles therein, allowing the resulting liquid to stratify; removing the driest portion of said liquid, passing a wetter portion through a water bath to wash out the water and suspended impurities therefrom; and removing the supernatant from said water bath.

No. 1,580,791, granted April 13 to Otto A. Peters, Wichita Falls, Texas, for an oil settling tank comprising a tank, a supply pipe leading within said tank and terminating adjacent the bottom thereof, a housing supported within said tank and having its upper end open whereby when the oil within the tank rises above the upper end of said housing it may flow therein, an oil outlet pipe communicating with the lower end of said housing and leading from said tank at a point above said housing, a water outlet leading from said tank below said housing, and a gas outlet leading from the hopper end of said tank.

No. 1,580,856, granted April 13 to William Cameron, Suez, Egypt, assignor to Simplex Refining Co., San Francisco, for a process of treating emulsions containing water having water soluble salts in solution therein comprising injecting said emulsion into a body of oil having a temperature above the boiling point of water, allowing the water vapor so produced to escape freely and maintaining the temperature of said oil by circulating dehydrated portions thereof over heated metal surfaces.

No. 1,581,205, granted April 20 to Ford W. Harris, Los Angeles, Calif., assignor to Petroleum Rectifying Co., Los Angeles, for a process of dehydrating petroleum emulsions which comprises: establishing a high potential electrical field in a body of said emulsion so that there is a tendency for conducting chains to be formed in said field; and superimposing upon said electrical field a magnetic field formed by secondary conducting chains through said emulsion, said secondary chains being so formed that they do not impair the potential of said high potential electric field.

No. 1,581,212, granted April 20 to Fred E. Hosmer, Fort Worth, Texas, for method of recovering vapors from gases, comprising supplying the gas together with a certain amount of additional vapors directly to the suction side of a pump, compressing and cooling the mixed gas and vapors, further precooling by heat transfer to cold dry tail gas, supercooling by evaporation of a portion of the liquid condensed in said various operations, returning the vapors produced in said evaporation back to the suction side of said pump and returning cold dry tail gases coming from the supercooling operation back for precooling.

No. 1,581,369, granted April 20 to James W. Weir, Fillmore, Calif., for a method of refining lubricating oil stocks, which comprises treating the oil with sulphuric acid, settling and removing the major portion of the sludge, treating the oil stock with comminuted solid adsorbent material at a temperature sufficient to decompose the sludge present and liberate sulphur dioxide therefrom, then adding litharge to the mixture, and thereafter separating the oil stock from the admixture.

No. 1,581,370, granted April 20 to James W. Weir, Fillmore, Calif., for process of manufacturing lubricating oil stock, which comprises treating the oil stock with sulphuric acid, removing the sludge, neutralizing the stock with an alkaline substance, separating such substance from the oil stock, thereafter applying further sulphuric acid to the oil stock, settling and removing the formed sludge, then agitating the oil stock with a comminuted solid adsorbent material at a temperature below that at which the sludge decomposes to gather a further quantity of the solid suspended sludge, separating the adsorbent material with the matters adsorbent thereon from the oil stock, then adding a comminuted solid adsorbent material to the oil stock, heating the admixture to a temperature sufficient to decompose the remaining sludge and liberate sulphur dioxide therefrom, and separating the adsorb-

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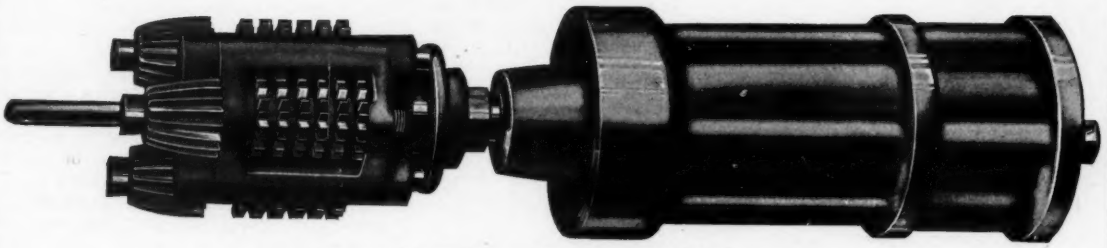

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ent material with the matters adsorbent thereon from the oil stock.

No. 1,581,371, granted April 20 to Edwin C. Weisgerber, Long Beach, Calif., for a gas and oil separator comprising a chamber having a gas and oil inlet, and a gas dome upon said chamber, perforate means within said chamber to divide the oil, perforate means to permit the released gas to escape and entrap oil particles carried by the gas, a gas cage in said dome to arrest passage of oil globules, and a gas conduit for preventing the oil contacting with and surrounding the perforate oil entrapping means.

No. 1,581,879, granted April 20 to James M. Sims and Olpha M. Brooks, Shreveport, La., for a still for distilling oil, having a coil heating chamber formed of bolted steel tubes lined with clay material, and a continuous coil for the oil formed of a series of short tubes mounted in the wall and extending transversely of the heating chamber, and return bends removably connecting the ends of the adjacent tubes and located outside of the walls of the heating chamber, substantially as set forth.

No. 1,581,895, granted April 20 to Frank E. Wellman, Kansas City, Kans., assignor to the Kansas City Gasoline Co., Kansas City, Kans., for an apparatus for cracking hydrocarbons, comprising the combination of cracking tubes, connected with a circulating pump having a discharge pipe leading to a feed manifold from which distributing pipes are led to the cracking tubes, the pump having a capacity of greater than the capacity of said distributing pipes, together with a blow-out for carbon from a low point in the system on the intake side of the pump, and an inlet feed connection for fresh oil on the delivery side of the pump, said distributing pipes and cracking tubes being arranged with a downward inclination in the direction of forced circulation and connected to pass the entire mobile contents of the tubes directly to the pump or blow-out.

No. 1,581,896, granted April 20 to Frank E. Wellman, Kansas City, Kans., assignor to the Kansas City Gasoline Co., Kansas City, Kans., for a method of cracking oil without liability to burning on the container of precipitated constituents, which consists in maintaining the bottom of the body of oil at a temperature below that at which burning can occur, and applying heat in rotary progression at constantly changing points to said body above the bottom thereof.

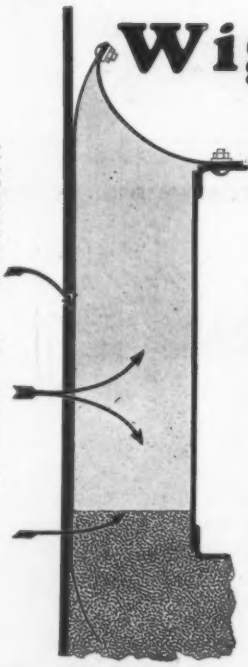
No. 1,582,123, granted April 27 to Edgar Milton Clark, New York, assignor to Standard Development Co. of Delaware, for a method of distilling crude petroleum for obtaining a maximum yield of substantially uncracked distillate therefrom which consists in carrying on the distillation of a body of said crude petroleum with the aid of injected steam and below cracking temperature until there is produced a residual fuel pitch in quantity substantially the same as the quantity of coke which may be produced by distilling the same oil to dryness by fire alone, and removing said fuel pitch from the still while it is in liquid condition.

No. 1,582,131, granted April 27 to Philip S. Danner, Point Richmond, Calif., assignor to Standard Oil Co., San Francisco, for a method of reclaiming a metallic halide from the sludges produced during its use in the conversion of hydrocarbons, which consists in the simultaneous cracking and hydrogenation of the highly unsaturated heavier hydrocarbons in these sludges, whereby lighter saturated hydrocarbons are produced, and the metallic halide is set free for further use in the treatment of new supplies of petroleum hydrocarbons.

No. 1,582,227, granted April 27 to Leland L. Rebber, Los Angeles, Calif., assignor to Union Oil Co., Los Angeles, for a process of preparing a mineral castor machine oil which comprises saponifying naphthenic acids, to produce a compound insoluble in water, then dissolving the naphthenic soaps in a mineral oil.

No. 1,582,257, granted April 27 to De Ralph Frizell, Los Angeles, and Bert Allen Stagner, Berkeley, Calif., assignors to Union Oil Co., Los Angeles, for a process of preparing soluble oils which consists in saponifying

why the Wiggins Seal is gastight



The narrow slot, 22 inches deep—the only oil surface ever exposed to evaporation. Opened only when the roof shoe travels over rivets and seams. The depth of the slot causes this small surface to be blanketed with heavy vapor.

The sealed gastight vapor space 1/10 actual size. Compare this small volume with the vapor space of the ordinary gastight tank. This seal discharges collected air, oil-free to atmosphere through a mercury-sealed vent.

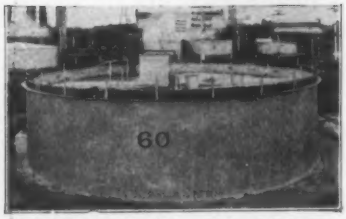
The oil level line.

THE Wiggins Seal is gastight to effectively close the space between the pan of the roof and the tank side. If this space is not closed gastight, exaggerated evaporation conditions from this area decrease the effectiveness of a floating roof.

Since the gastight volume of a Wiggins Seal on a 55,000-barrel tank is one per cent of the volume of a gastight tank, the thermal breathing loss is reduced to a negligible amount.

The Wiggins Seal does more than practically eliminate evaporation and losses through thermal breathing. It separates oil from air. Air, in bubbles, entering through the filling line, loses its entrained oil beneath the seal and is discharged to atmosphere through a mercury sealed vent.

Equip your present tanks with Wiggins Roofs. And when contemplating new tanks, get our quotations on them equipped with Wiggins Roofs.



A Wiggins Roof on an all-welded run-down Horton Tank at a refinery.

Chicago Bridge & Iron Works
Chicago, 2463 Old Colony Bldg.
New York, 3102 Hudson Terminal Bldg.
Cleveland, 2234 Union Trust Bldg.
Dallas, 1655 Praetorian Bldg.
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San Francisco, 151 Rialto Bldg.

WIGGINS ROOF

RNGM 6-Gray

EMPIRE OIL METERS

POSITIVE DISPLACEMENT OSCILLATING PISTON TYPE

The design of the EMPIRE is entirely different from that of any other type of oil meter. The construction of the measuring unit is such that what wear occurs is easily taken up by a very simple and inexpensive readjustment, and the meter is then once again in practically as good condition as when it first left the factory.

It is this feature of LASTING accuracy that sets the EMPIRE apart in a class by itself as a reliable measuring device. Every branch of the petroleum industry can be served by EMPIRE meters. They are made in both standard and high pressure types. We also make special types. Consult us freely as to your particular requirements.

EMPIRE METERS ARE MADE IN ALL SIZES FROM 5/8" to 6" INCLUSIVE

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299 Broadway, New York

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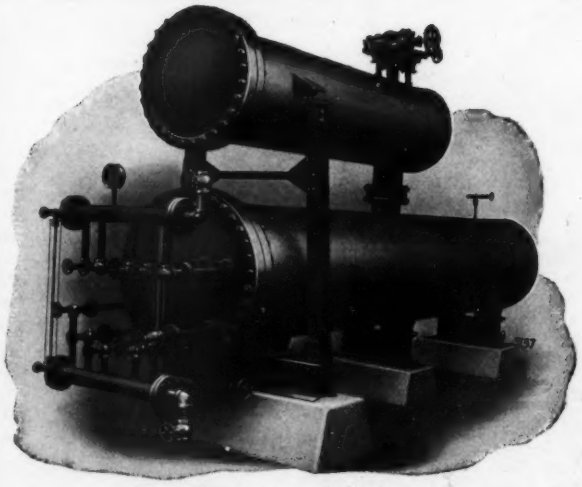

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ICE MAKING AND YORK REFRIGERATING MACHINERY

YORK Absorption Refrigerating Machines are built in either the double pipe, atmospheric, or shell and tube type, and consist principally of the following parts:

GENERATOR,
ANALYZER,
DEHYDRATOR,
CONDENSER,
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WEAK AQUA COOLER,
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STRONG AQUA TANK,
ANHYDROUS AMMONIA RECEIVER, AND AQUA AMMONIA PUMP.

This equipment is particularly adaptable to Refinery requirements, and can be relied upon to deliver low, dry temperatures WHEN and WHERE needed.
Write the nearest YORK Branch (there are 74 of them) for full particulars.

YORK MFG. CO., York, Penna.
Please send me data on York Mechanical Refrigeration for Refineries. No obligation on my part.

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York, Penna.

Mention Where You Saw the Advertisement

For Every Refinery Process, there is One Best Temperature.

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C. J. TAGLIABUE MFG. CO.
18-60 THIRTY-THIRD ST., BROOKLYN, N.Y.

Insist on Mercurial Thermometers with the TAG-Hespe RED Reading Column

SINCE 1760

TAG

naphthenic acids, mixing the naphthenates with cresol and dissolving the resulting compound of naphthenates and cresol in an oil.

No. 1,582,258, granted April 27 to De Ralph Frizell, Los Angeles, Calif., assignor to Union Oil Co., Los Angeles, for a castor machine oil comprising a naphthenic soap, an alkali metal naphthenate other than said soap, and an oil, the product being insoluble in water.

No. 1,582,310, granted April 27 to Georg Schroeter, Berlin, Germany, for a process of hyrogenating naphthalene which comprises treating a naphthalene of commercial grade, but free from all those impurities which are capable of producing a red coloration on treatment of said naphthalene with strong sulphuric acid, with hydrogen in the presence of a hydrogenation catalyst, and a process of hydrogenating naphthalene which comprises the steps of removing from naphthalene, while in fluid condition, constituents capable of acting as catalyzer poisons and then subjecting the purified naphthalene, while still in fluid condition, to the action of hydrogen in the presence of a hydrogenation catalyst.

No. 1,582,404, granted April 27 to Edwin F. Hurst, Brea, Calif., for a dehydrator for petroleum emulsions, consisting, in combination, of walls forming a treating chamber; walls forming a preheating chamber, said preheating chamber being situated above said treating chamber; a fire box situated in the lower portion of said treating chamber; fire tubes within said treating chamber, said fire tubes extending from the top of said fire box to the top of said treating chamber; tubes extending through said preheating chamber; said tubes being in communication with said fire tubes; a burner for producing heat, the products of combustion of said burner passing through said fire box, said fire tubes and said tubes, heating said treating chamber and said preheating chamber; a liquid in said treating chamber, said liquid being heated by said products of combustion; piping for introducing emulsion into said preheating chamber where it is preheated; a treating coil located in said treating chamber; and piping for conducting said emulsion from said preheating chamber to said treating coil.

No. 1,582,407, granted April 27 to Kenneth V. King, Berkeley, Calif., assignor to Standard Oil Co., San Francisco, for a container, receptacle, or the like for a hydrocarbon oil cracking operation having a hydrocarbon contacting surface eletrolytically plated with chromium to render the container, receptacle, or the like resistant to the action of corrosive agents produced by the cracking operation.

No. 1,582,540, granted April 27 to Oren B. Riddle, Tulsa, Okla., for an apparatus for separating casing head gas from oil comprising a tank, oil supply pipes extending downwardly into the tank, and upwardly directed deflectors on the discharge end of the supply pipes for spraying the oil against the inner wall of the tank whereby the gas is separated from the oil.

No. 1,582,585, granted April 27 to Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Co., Chicago, for an apparatus for distilling and condensing hydrocarbons under pressure of generated vapors, including, in combination with a plurality of stills, said stills being located at progressively different heights, means for heating said stills each to a given temperature, a plurality of reflux condensers disposed above said stills and in communication therewith, means for

PORTABILITY
with stationary efficiency & better
A "SOUTHWESTERN" ABSORPTION PLANT

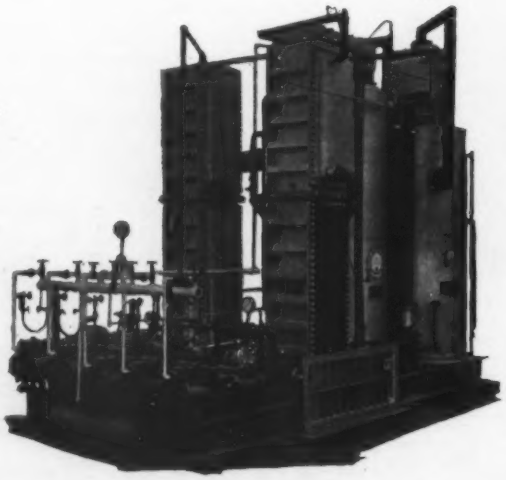
In Oklahoma recently, decision was made to move a Southwestern Gasoline Absorption Plant, to a new location several miles distant; the Boiler Plant was already there. Dismantling was started in the morning and eight hours later, the Plant was MAKING GASOLINE at the new location.

Southwestern Portable Absorption Plants provide every feature desired and incidentally establish high records of performance.

Each unit, through correct engineering and scientific designing, is of minimum size and weight and sold with a positive guarantee of performance. You can depend on Southwestern.

Catalogue R on request

SWEC



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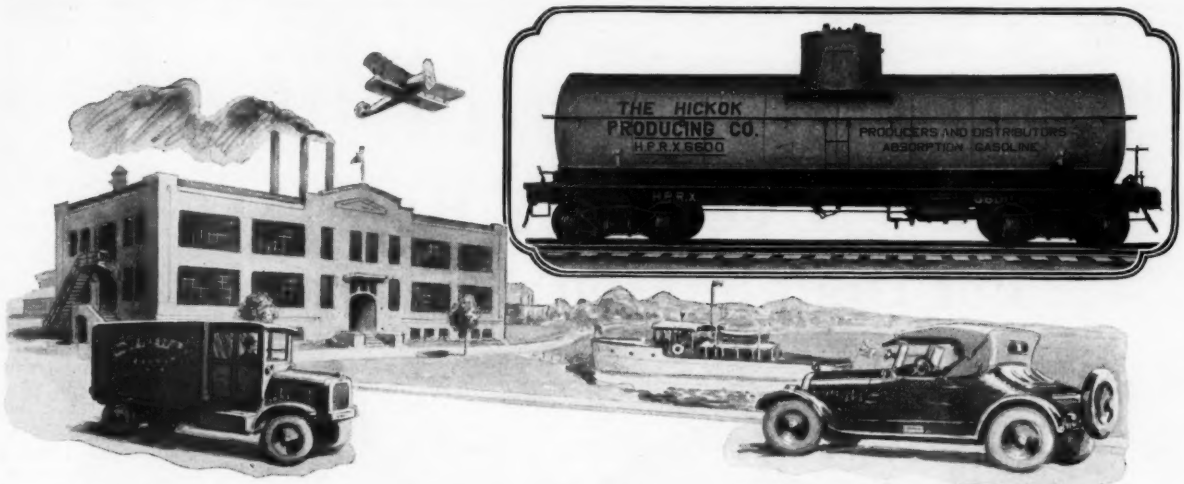

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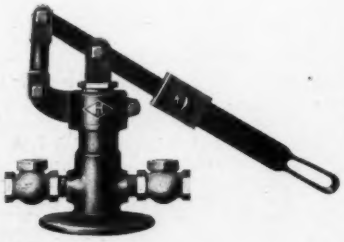
Hydraulic Punches



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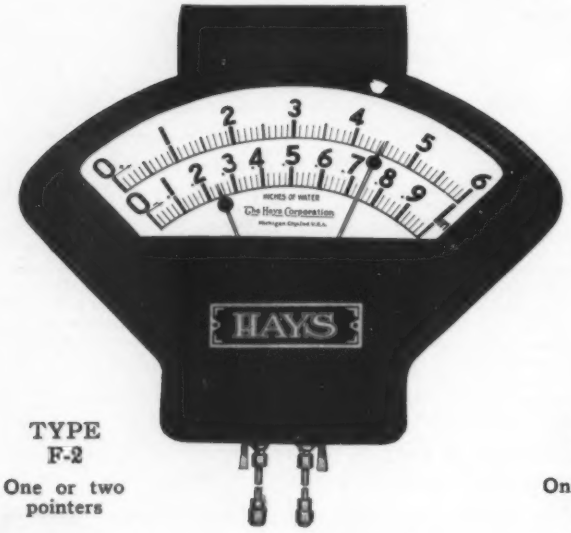
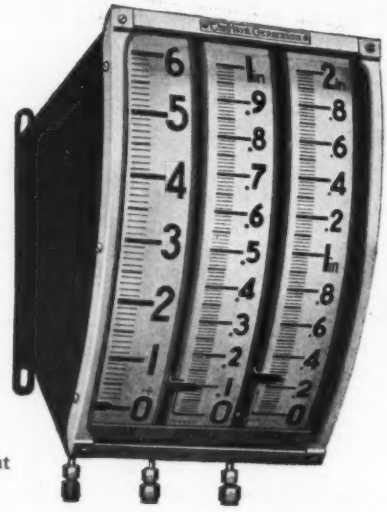


TYPE F-2
One or two pointers



TYPE V-3
One to eight units

Combining Visibility, Simplicity, Sensitiveness, Ruggedness, Accuracy, Dependability

Hays Pointer Gages are **new** in principle and design. They do not employ liquids, floats, tanks, gears or magnets. Levelling is unnecessary, calibration is permanent.

Large Illuminated Scales with heavy black figures, uniform graduations, are readable at 50 to 100 feet —clear across boiler-room.

Any range of draft, pressure, balanced draft or differential from a total scale range of 1/10-inch to 30 inches water can be supplied. Any number of scales may be combined in a single case.

Type "F" for one or two units, provides a large flat case of pleasing appearance with a 19-inch window. Bright red pointers stand out conspicuously and show the fireman every slight change in furnace conditions.

Type "V" provides a compact arrangement for any number of units, with scales side-by-side and reading from bottom up. Illumination is from within. Scales measure 12 x 2¼-inch.

A striking feature is the simplicity and ruggedness of the operating mechanism in which a special slack leather diaphragm produces the smoothest and most definite action imaginable. No dashpots or dampers are required. No. surging, no changing liquid levels, no corrosion.

A Catalogue describing this wonderful line of new gages will be mailed to interested parties on request.

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Texas Refining Plants Adopting Natural Gas for Fuel

By H. H. King
Staff Representative

Fort Worth, Texas.—The major portion of the cracking and skimming units operating in the various refining centers in Texas will be burning natural gas for fuel before the close of the present year. This widespread use of natural gas has been made possible through the construction of huge gas lines from prolific gas fields in Southwest Texas to Houston and nearby refining centers located on tidewater; the completion of a 50,000,000 cubic foot daily capacity line from North Louisiana and Northeast Texas fields by Magnolia to its principal refinery and topping plant at Beaumont; and the starting of a trunk line from the Texas Panhandle district to the North Texas refining district, while the reduction of the tariff on gas to industrial consumers by the Lone Star Gas Company has enabled a number of large refining plants at Fort Worth and Dallas to economically burn gas during certain seasons of the year.

Nearly a score of cracking and skimming plants operating at Electra, Iowa Park, Wichita Falls and Burkburnett will discontinue the use of oil for fuel and burn natural gas when the D. A. Upham Gas Company of Texas' gas main is completed early next winter from the Shamrock oil and gas field in the eastern part of the Texas Panhandle. Five year contracts have been signed by a number of these North Texas plant owners to purchase gas at a fixed tariff for this period from the Upham Gas Company. Refining plants having a monthly consumption of 60,000,000 cubic feet of gas, or more, will obtain a minimum rate of 11c per thousand cubic feet, while the maximum rate is 17½c for those burning from 1½ to 5 million cubic feet of gas monthly. Eight separate rates are posted on the gas price schedule ranging from 17½ to 11c. The Texhoma Oil & Refining Company, Panhandle Refining Company and the American Refining Company, all equipped with cracking units and located at Wichita Falls, are to be the heaviest consumers of natural gas due to the size of their respective plants.

The natural gas price schedule given below is the basis on which North Texas refiners are to fill their fuel requirements over the next five years, being divided up into eight separate tariffs:

	Cu. Ft. per month	Per 1000 Cu. Ft. Net
(1)	1½ to 5 million	17½c
(2)	5 to 10 million	16½c
(3)	10 to 20 million	15c
(4)	20 to 30 million	14c
(5)	30 to 40 million	13c

---

feeding oil through said reflux condensers, to preheat the same and then to the stills, communications between all of said stills, valves for controlling the number of reflux condensers through which the oil must pass before entrance to the stills, auxiliary condensers disposed above said reflux condensers and in communication therewith, valves for controlling by-pass communications around such auxiliary condensers, outlets from said auxiliary condensers, additional condensers in communication with said outlets, a receiving tank communicating with said last mentioned condensers, and means for maintaining a pressure on oil during distillation and condensation in the apparatus.

No. 1,582,588, granted April 27 to Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Co., Chicago, for a dephlegmator, comprising a casing, having a vapor inlet and a vapor outlet, a plurality of vertically spaced perforated plates mounted within said casing to obstruct the travel of vapors through the dephlegmator, manually adjustable means associated with each plate for maintaining the plates in any desired vertical positions of adjustment relative to one another.

No. 1,582,764, granted April 27 to William Landes, Long Beach, Calif., for a process of obtaining a light hydrocarbon consisting in atomizing oil with steam into a chamber, and simultaneously atomizing hydrocarbon gas with steam into the chamber independently of and below the oil so that the gas intercepts particles of oil that drop from above.

Edward Forged Steel Valves

—the best valve for refinery service.

Designed and built for service up to 500 pounds pressure and intermittent temperature to 1100° F.—they will fit any requirement.

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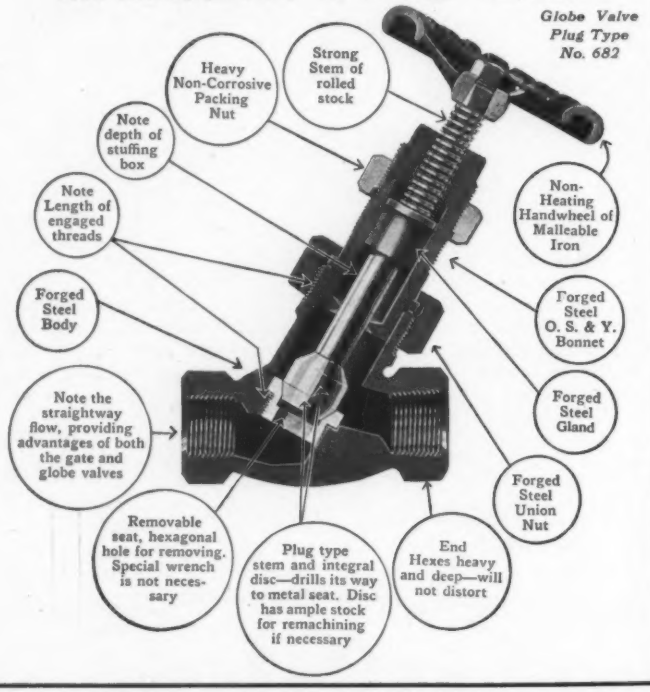
Power Plant Equipment Co., 123 W. 1st St., Tulsa, Okla.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Plug Type
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Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
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Non-Heating Handwheel of Malleable Iron
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Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
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(6) 40 to 50 million 12c
(7) 50 to 60 million 11½c
(8) 60 million, and above.....11c

The Upham Gas Company has contracted to deliver North Texas refiners gas that will test 1,000 B. T. U.'s, or better, and is scheduled to begin delivering gas into Wichita Falls by September, 1926. The gas line will consist of about 31 miles of sixteen-inch pipe leading out of the gas field, to the town of Wellington, where the line will be divided into two 12-inch carriers, one of which extends over into the southwest corner of Oklahoma. The two 12-inch lines merge at Quannah, and from this point to Wichita Falls, 16-inch pipe will be used in the line. A natural gasoline plant is to be constructed on the line near the field, as the gas offers a profitable gasoline yield when volume is attainable.

Magnolia Petroleum Company was the first major refining concern in Texas to adopt natural gas for fuel in the operation of cracking, skimming and lubricating units as well as filling all other fuel requirements at its complete refinery at Beaumont with natural gas. Magnolia built a line to North Louisiana and North East Texas to obtain its fuel requirements, and completed the line early last year. Humble, Sinclair, Galena Signal and other large refining concerns operating near Houston have started using natural gas for a large percentage of their plant fuel requirements since the recent completion of two large gas lines from the Southwest Texas gas fields.

Increased use of natural gas for fuel has taken place lately in the Fort Worth and Dallas cracking and skimming plants operated by major companies and independent companies. The Simms Oil Company at Dallas is using gas at certain seasons of the year for fuel when fuel oil has a greater market value through cracking, or direct sale to consumers. The Texas Company and Oriental Oil Company are also making use of natural gas for fuel at various seasons of the year to a limited extent. In Fort Worth, The Transcontinental Oil Company, which has a complete skimming, cracking and lube plant, is preparing to change from oil to natural gas for its entire fuel requirements, and has 50 per cent of the change completed, and ready for operation. Transcontinental is using 10-inch pipe in its feeder line, and six-inch pipe in the distributing lines serving the various units at its plant. The burners are being regulated to burn gas at a pressure of from four to eight ounces, while provisions are being made to revert back to fuel oil on instant notice.

The Dallas and Fort Worth refineries are supplied with gas from the Lone Star Gas Company's system, and a minimum rate of 16½ cents per thousand cubic feet of gas is available to the largest industrial consumers. Owing to Lone Star serving all the principal cities and towns in North and

Central West Texas, industrial consumers are subject to being cut off from their gas supply on short notice during the winter peak load periods and when breaks occur in the trunk lines, but the cut offs only occur a few days throughout the year. The Gulf Refining Company and Magnolia Petroleum Company are taking gas from Lone Star to operate gas engines in their Fort Worth plants, and for other power purposes, while Texas Pacific Coal & Oil Company is reported to be considering the use of natural gas for fuel when its skimming and lube plant at Fort Worth is placed in operation shortly.

While the adoption of natural gas for fuel in Texas refineries affords a saving in plant operations, it is also expected to have some reaction on the fuel oil market over the state, due to natural gas also becoming available to industrial plants that have been the major consumers of fuel oil, except for the railroads.

New Theory on Detonation Offered

(Continued from page 32.)

perature which will cause it to begin to function just with or just after ignition of the charge by the spark plug."

Essential Properties

Five properties, according to the researchers, are essential to this ideal anti-knock. The first is volatility, with the boiling point under 400 degrees Centigrade. The second is that the amount of free metal liberated when the compound is heated in the air should be complete. The decomposition temperature should be between 200 and 300 degrees Centigrade. Temperatures developed by oxidation of the metal should be high compared to ignition temperatures of the fuel. The particles should be of colloidal size to favor rapid oxidation.

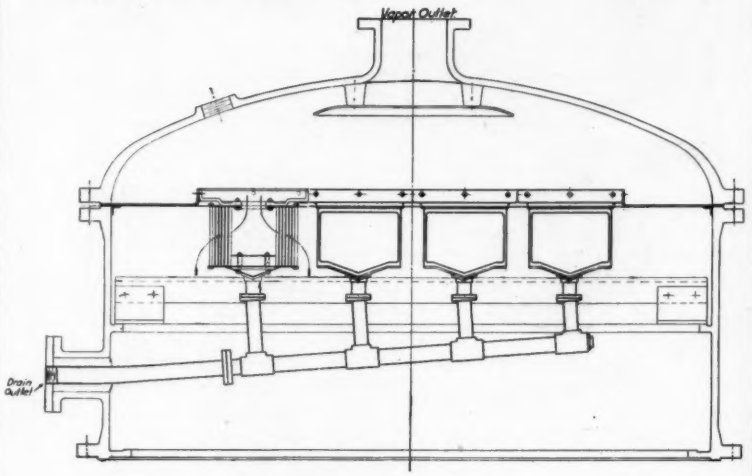
The knock in an automobile engine, it was explained, is supposed to be due to the fact that the burning of part of the gas mixture so compresses the unburned portion, that this unburned portion becomes hot enough to ignite spontaneously.

The burning of the gas is analogous to the burning of a firecracker, which takes a finite time to happen, while the spontaneous ignition of the remaining gas is analogous to the explosion of the firecracker itself, which happens at almost infinite velocity.

The little particles of lead distributed throughout the gas mixture vastly increase the swiftness of the flame travel and make it possible for the flame to reach every part of the gas before it has had a chance to ignite spontaneously.

Important to chemical science, it was said, was the finding by the investigators of a method of comparing one anti-knock with another. On the basis of this disclosure the table of values with tetraethyl lead as the dominant compound was constructed.

Mist Is *Completely* Extracted From Gas



By the Tracyfier Gas Scrubber

ALL entrained liquid is scrubbed from the gas, delivering it Dry and Clean. Separation is done AT LOW VELOCITY. Dry Gas increases your control of gasoline quality, eliminates entrainment losses, decreases maintenance.

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Now used by Sinclair Oil & Gas Co., Simms Oil Co., United Natural Gas Co., Skelly Oil Co., Tidal Refining Co., W. M. Welch Co., Atlantic Refining Co., Hope Natural Gas Co., Barnsdall Refining Co., Chestnut & Smith Corp., Indiana Refining Co., Magnolia Petroleum Co., M. W. Kellogg Co., Marland Refining Co., Owens Bottle Co., Mars Company, Pacific Gasoline Co., Reserve Gas Co., Peoples Natural Gas Co.

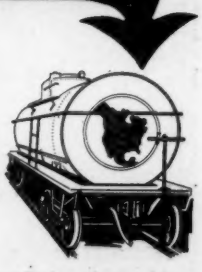
You will be interested in Bulletin No. 33

ANDREWS-BRADSHAW COMPANY

530 Fourth Avenue Pittsburgh, Pa.

$175,000 Loaned to a Refiner Last Month!

In April we entered into leasing arrangements with a Mid-Continent refiner. In effect, we loaned him $175,000 in cash. He exercises control identical with ownership. His credit enables a flexibility of supply comparable to a bank loan, with freedom from repairs, taxes, depreciation, interest on the investment and periodic upkeep expense. The cost is inconsiderable . . . . Any wonder so many refiners take advantage of North American Leasing Service?



North American Car Corporation

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To Prevent a Vacuum

The *Fulton Duplex Sensitive Vacuum (or Back Pressure) Regulator* is designed for use on a system discharging gases to a line under light vacuum, where it is desired to maintain atmospheric pressure.

This Regulator acts as a safeguard when used on the vapor lines connected to storage tanks and prevents the pulling of a vacuum when adjusted as a vacuum regulator.

The same regulator may be adjusted to act as a *Duplex Back Pressure Regulator* and will control a slight pressure above atmosphere with the same accuracy as when used to control a light vacuum.

Send for catalogue.

CHAPLIN-FULTON MFG. COMPANY

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METALLO

saves steam

SAVING steam is saving money. Metallo Gaskets make leak-tight joints.

For each Metallo Gasket is a series of joints of 14-oz. deeply corrugated copper and finest grade closely woven asbestos cord alternately.

Metallo "Refinery Type" Style No. 1000 Metal gaskets are made with a double jacket of this special metal, scientifically annealed, and a filler of the highest quality of asbestos. The result is a gasket particularly adapted for use on joints on cracking stills where the pressure is up to 900 pounds and the temperature to 1200 degrees F.

Write for new catalog

Metallo Gasket Company

New Brunswick, N. J.

Abstracts of Refining Technology

Valuation of Gasoline and Lubricating Oils.—The tests which are essential for determining the suitability and value of lubricating oils are specific gravity, viscosity, cold test, flash point, coke tests and appearance. The gravity, in connection with the other values, may indicate the origin of the oil. High flash point indicates close fractionation in refining. The readings of the viscosimeters which are in general use are not direct functions of the absolute viscosity.

Load factor and the age of the engine may decide the viscosity of the oil to use, but the size of the engine alone is not the determinative factor. Pennsylvania oil falls off less in viscosity with rise in temperature than do Texas and California oils. The heavier blends of cylinder oils contain at least two different bases. The presence of paraffin wax leads to high cold tests. Wax-free oils may be obtained with cold tests below minus 7 degrees C. The coke test indicates liability to carbon deposit in cylinder, engine conditions being the same.

In the same class, the lighter colored oil is generally the better. Compounded oils have the faculty of maintaining a film under extreme pressure. The tests for gasoline are specific gravity, Engler distillation, corrosion test and aniline cloud test. The higher the specific gravity the greater the power obtainable per unit volume. Ease of starting is determined by the amount of gasoline which distills over from the initial boiling point to a temperature of 100 degrees C. The aniline cloud test is a measure of the aromatic hydrocarbons which are present in the gasoline, and also of the tendency to detonate. Lead tetraethyl as an antidetonator may be used and also ethyl alcohol. J. Inst. Petroleum Technologists, volume 11, pages 571-575,

* * *

Theory of Anti-Detonators—In an article published in Chimie et Industrie, volume 14, page 851, the author suggests that the action of anti-detonators such as lead tetraethyl in internal combustion engines is due to the formation of a cloud of solid particles, which fix a proportion of the ions in the gas, and thus moderate the rate of explosion. The fact that benzene-air mixtures can be strongly compressed without detonation is ascribed to the initial combustion of the hydrogen, whereby a cloud of carbon particles is formed and acts as an anti-detonator.

* * *

Cracking Solid Paraffines—In the German journal, Zeitschrift fuer ange-

wandte Chemie, volume 39, pages 194-6, there is contained a very interesting article, which deals with the cracking of solid paraffines with the formation of low boiling products, and in which process activated carbon is employed.

A solid paraffine, which has a melting point of 50 to 52 degrees C., distilled in contact with activated carbon at a temperature of approximately 300 degrees C., under atmospheric pressure, yielded 22 per cent of a light oil of 45 to 150 degrees C. boiling point, also 13.4 per cent of a heavier oil of 150 to 200 degrees C., and 21.2 per cent of an oil of 210 to 300 degrees C. boiling point. These yields are all reckoned on the weight of oil obtained per unit weight of solid raw material.

Further quantities of light oil could be obtained by subjecting the oily distillate above a temperature of 300 degrees C. and the unchanged paraffin to a further distillation, with activated carbon, giving a total yield of 27 per cent of light oils distilling below a temperature of 150 degrees C. This compares very favorably with the yield of 4 to 12 per cent obtained by cracking crude petroleum.

The process can be carried out at atmospheric pressure or at reduce pressure for paraffines which have boiling points in excess of 300 degrees C., which simplifies the plant that is required for carrying out the process in a practical manner, while no appreciable quantities of coke or asphalt are produced. This means that the life of the apparatus is prolonged. Materials with a boiling point that is below that of the decomposition temperature must be distilled under a pressure of 10 to 25 atmospheres, which is sufficient to raise the boiling point to the required temperature, generally about 300 degrees C.

Products of Hydrogenation of Paraffine—Paraffine was subjected to the action of hydrogen gas at high pressure and at a temperature of 450 degrees C. Liquid reaction products were obtained and the properties of these products were examined and are described in Rec. trav. chim. Pays-Bas, volume 45, pages 284-95.

Rangoon paraffin was heated. This paraffin contains 84.6 per cent of carbon and 14.8 per cent of hydrogen. The heating took place in an autoclave for a period of ninety minutes at a temperature of 450 degrees C. under the influence of hydrogen gas. The pressure rose to a maximum of 290 atmospheres during the progress of the experiment. From four hundred grams of the original paraffin about 360 grams of a liquid product were obtained. This product had a density of 0.722 to 0.733 at 19 degrees C. Distillation was resorted to in order to separate this liquid into two fractions.

The first fraction was taken off at a temperature of 150 degrees C., and

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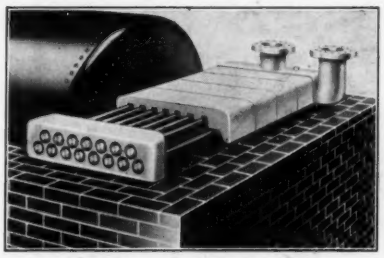

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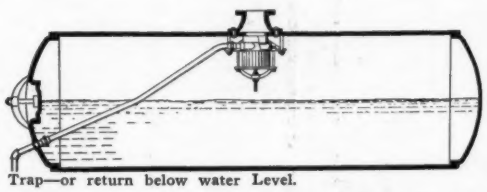

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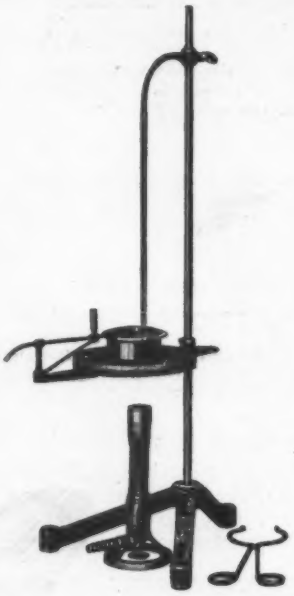

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amounted to about 40 per cent of the total original liquid. The second fraction, which boiled at a higher temperature, consisted of non-decomposed or only slightly decomposed paraffin and solidified at a temperature of 12 degrees C. By careful examination of the first fraction, it was found to contain aliphatic hydrocarbons, from pentane to nonane, mixed with approximately ten per cent of olefines. Benzol could not be found, but a small amount of toluol was present.

* * *

Sulphonic Acids From Mineral Oils—Suphonic acids are obtained from mineral oils by treating them with sulphuric acid or a mixture of sulphuric acid and sulphur trioxide, separating the sulphonic acid or suphonated oil, and treating the latter with acetic acid or a water soluble ester of this acid, for example, the ester with methanol or glycerine. The sulphonated oil may be treated with water or aqueous alkali solutions, in order to obtain a solution of the sulphonic acids or sulphonates, before treating with acetic acid or its water soluble ester.

Thus for example a spindle oil from Baku naphtha is treated with sulphuric acid and sulphuric anhydride, separated from the acid resin formed, and the sulphonated oil is then heated with methyl acetate to deposit the sulphonic acids, and in another case a solar oil distillate is similarly sulphonated and neutralized with dilute sodium hydroxide solution. The layer containing the sulphonates is separated and treated with sodium chloride, and the mixture of sulphonates and mineral oil thereby obtained is heated with acetic acid, when the oil separates out. British Patent No. 247,940.

* * *

Micrographic Analysis of Mineral Oils—In Bul. Soc. Chim. Romania, 1926, volume 7, pages 93-99, there is discussed the micrographical analysis of mineral oils which have been subjected to oxidizing processes. Samples of oil were heated at a temperature of 250 degrees C. for varying periods ond examined microscopically, the time required for the first precipitation of asphalt being noted. This test gives a much more reliable indication of the value of the oil than the older tests of viscosity, inflammability, covering power, and the like.

Chemical analysis of the oil after heating gives results which agrees with the microscopical method, but the latter is much quicker and more delicate for detecting the first changes. By the use of various solvents on the precipitates it is shown that the oxidation proceeds in the order: oil to hard asphalt, to soft asphalt to carbene (colloidal carbon) to coke. The long periods of heating may be avoided by the use of nitric acid. A thin film of oil

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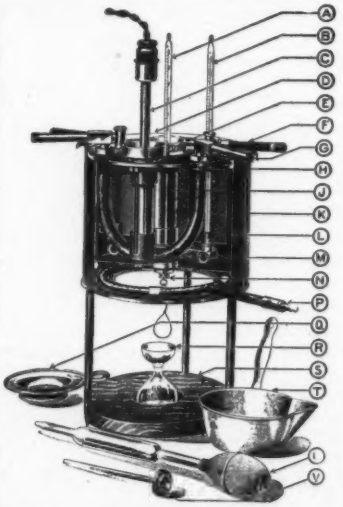

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is placed under the microscope and a drop of a solution of nitric acid added. If the concentration of the acid exceeds a certain limit an immediate precipitation of asphalt occurs, and by noting the limiting concentration of nitric acid required by different oils, the resistance of the oils to oxidation is obtained. Results thus obtained agree with those found by prolonged heating at 250 degrees C.

Ljungstrom Air Preheater Recovers Flue Gas Heat

An air preheater said to recover 70 per cent of the heat in the flue gases has recently been put on the market by The Air Preheater Corporation, 25 Broadway, New York City, New York.

This preheater is called the Ljungstrom Air Preheater, and is described as follows:

Housing. The housing is constructed of steel plates of ample thickness. Joints are electric welded. The housing is divided horizontally into three compartments. The middle one contains the rotor heating elements. The upper and lower compartments are divided vertically so that the flue gases are confined to one side of the Preheater, and the air to the other. Suitable manholes are provided for inspection purposes.

Rotor. The framework of the rotor is built up from sheet steel. All joints are electric welded. It is divided into a number of sections which carry the heating elements. These are formed by alternating crimped steel plates with plain sheets inserted concentrically, thereby forming a honeycomb structure. A large heating area is obtained in a very confined space. The rotor is driven by a rack and pinion, the rack being fastened to the top side of a heavy circular steel ring.

Fans. High efficiency is obtained with Ljungstrom propeller type fans. Since the forced and induced draft fans operate with cold air and cooled flue gases respectively, the power required for driving purposes is consequently reduced to a minimum. The blades may be set at any angle within wide limits. This, in conjunction with the regulation of the speed of both fans, makes it possible to control the air supply closely and maintain balanced draft in the furnace.

Soot Blower. This consists of two pipes, one above and one below the rotor, each pipe running from the circumference to the center and having a large number of nozzles suitably spaced for effective sweeping of the elements.

A double soot blower valve is furnished. This valve is automatically self-draining and allows dry steam to be blown alternately to the two steam pipes. A complete blowing of the Preheater is effected in less than one minute, and usually the Preheater has to be blown from one to three times a day.

More complete information may be had by communicating with the company direct.

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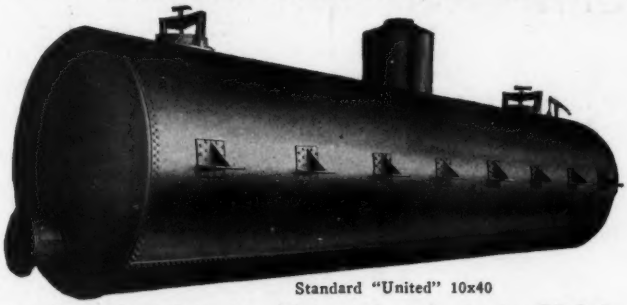

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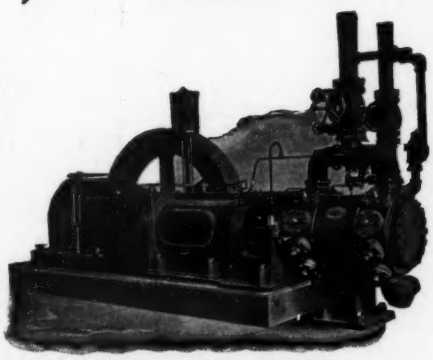

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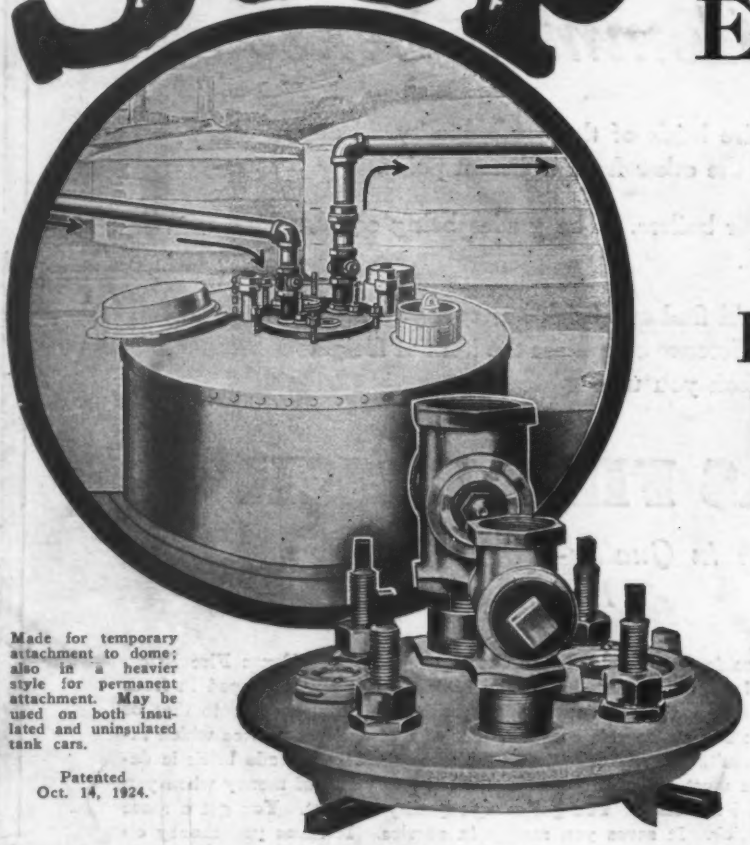

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